With BRITISH INDUSTRIES FAIR SUPPLEMENTS.

MAR 4 1929

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLVII.—No. 3814] LONDON: FRIDAY EVENING, FEBRUARY 15, 1929 [PRICE { WITH SUPPLEMENTS } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director - General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—
626 VACUUM BRAKE CYLINDERS.
Tenders due on the 28th February, 1929.
Forms of Tender available from the above at a fee of 5s., which will not be returned. 1008

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.
APPLICATIONS from qualified candidates are INVITED for the following POSTS :—
M/1337.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of HONG KONG for the PUBLIC WORKS DEPARTMENT, for three years' service, with possible permanency. Salary £460, rising to £500 a year by annual increments of £20, and thence (if appointment is made permanent) to £1000 a year, payable locally in dollars under the compensation scheme at present in force at a favourable rate of exchange. Free first-class passages provided. Candidates, unmarried, 22 to 26 years of age, must have passed Sections "A" and "B" of the examinations to qualify for Associate Membership of the Institution of Civil Engineers, or hold professional qualifications recognised by the Institution as exempting from those examinations, must be thoroughly conversant with and have had experience in the maintenance and construction of roads and must be able to carry out surveys and make all plans necessary for the preparation of details of design and to prepare bills of quantities for letting of work on contract in connection with road construction, including bridge work in reinforced concrete and the construction of buildings. Candidates must be able to ride a motor cycle.

M/1322.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of UGANDA PUBLIC WORKS DEPARTMENT for a tour of 20 to 30 months' service, with possible extension. Salary £480, rising to £600 a year by annual increments of £20 and thence rising to £720 a year by annual increments of £30. Free quarters and passages, liberal leave on full salary and outfit allowance of £30 on first appointment. Candidates, preferably single, 25 to 30 years of age, must have passed Sections "A" and "B" of the examination to qualify for Associate Membership of the Institution of Civil Engineers or hold professional qualifications recognised by the Institution as exempting them from those examinations. Must have a sound knowledge and experience of building construction. Candidates who have had training and experience in a Municipal Engineer's office will be given preference.

M/1332.—ASSISTANT ENGINEER REQUIRED for the PUBLIC WORKS DEPARTMENT of the STRAITS SETTLEMENTS for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Straits Settlements Government. Free passages provided. Candidates, age 23 to 26, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtain such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case, or have completed articles with a civil engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.

Apply at once by letter, stating age and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 1004

The Government of INDIA REQUIRE TWO INSPECTORS OF STORES (STRUCTURAL)
for service in the Indian Stores Department. Candidates must possess a University Degree in Engineering or good general education up to the standard of the Institution of Civil Engineers or of the Institution of Mechanical Engineers, and drawing-office experience, and have served a regular apprenticeship in structural engineering workshops. It is essential that they should have specialised in structural steel and bridge work. Age preferably between 24 and 33 years of age.

Agreement for five years in the first instance. The scale of pay applicable to both appointments is Rs. 500, rising by annual increments of Rs. 50 to Rs. 750 a calendar month, with a personal allowance of Rs. 200 a month and certain other allowances. The selected candidates will be granted a commencing rate of pay within this scale commensurate with their age and qualifications. Free first-class passage to India. Provident Fund.

Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 23rd February, 1929. 891

Heriot-Watt College, EDINBURGH.
PROFESSOR OF MECHANICAL ENGINEERING.
The Governors invite APPLICATION for the PROFESSORSHIP of MECHANICAL ENGINEERING, which will shortly become vacant owing to the retirement of Professor Richard Stanfield, M. Inst. C.E., A.R.S.M.

The Professor is head of the Mechanical Engineering Department, which includes Day Courses of University standard and Evening Courses of study. The person appointed will be required to take up his duties on 1st September, 1929. Salary £1000 by £50 to £1200. Particulars may be obtained from the Principal at the College, to whom applications should be sent by 16th March.

949 J. CAMERON SMAIL, O.B.E., Principal.

The Engineer

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PUBLIC NOTICES

University of London.
A COURSE of FIVE LECTURES, with lantern illustrations, on "HIGH-VOLTAGE CABLES," will be given (in English) by Mr. L. Emanueli (of Milan), Chief Electrical Engineer of the Pirelli Cable Manufacturing organisation), at the INSTITUTION OF ELECTRICAL ENGINEERS (Victoria Embankment, W.C. 2), on FEBRUARY 20th, 22nd, 26th, March 1st and 5th, at 5.30 p.m. At the first Lecture the chair will be taken by Professor C. L. Fortescue, O.B.E., M.A., M. Inst. C.E., M.I.E.E. (Dean of the Faculty of Engineering in the University).
ADMISSION FREE, WITHOUT TICKET.
EDWIN DELLER,
913 Academic Registrar.

Administrative County of LONDON.
NORTHERN OUTFALL WORKS, BECKTON.
RECONSTRUCTION OF JETTY.
The London County Council invites TENDERS for the RECONSTRUCTION in REINFORCED CONCRETE on PILE FOUNDATIONS of a JETTY, 16ft. in width and about 550ft. in length, in spans of 42ft., with Rail Tracks and Ducts for Pipes; the RECONSTRUCTION and WIDENING in TIMBER of PART of the PIERHEAD; the SUPPLYING and LAYING of a total length of about 600 Lineal Yards of 24in. diameter CAST IRON PIPES and other incidental Works.

The specification, form of Tender, &c., may be obtained on application to the Chief Engineer, the Old County Hall, Spring-gardens, S.W. 1, upon payment of £5 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, at the Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 3A at No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, the 18th March, 1929, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
973 Clerk of the London County Council.

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for :
FOUR 2-6-2 TYPE SUPERHEATED ENGINES WITH TENDERS, 2ft. 6in. Gauge.
DELIVERY F.O.B. TO BE COMPLETED BY 30th SEPTEMBER, 1929, AT LATEST.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Monday, 11th February, 1929.

A fee of 20s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Monday, 25th February, 1929.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
945 Secretary.

City of Liverpool.
CITY ENGINEER'S DEPARTMENT.
TRAMWAY MATERIAL.
The Corporation are prepared to receive TENDERS for the SUPPLY and DELIVERY of various classes of TRAMWAY MATERIALS, as under :—
SCHEDULE No. 1.—Steel Tramway Rails and Fish-plates.
SCHEDULE No. 2.—Steel Fish Bolts.
SCHEDULE No. 3.—Steel Tie Bars.

Firms are required to state clearly, when making application for the necessary Tender forms, the name and number of the Schedule for which they desire to be furnished with Tender form.

Duplicate forms of Tender for record purposes will NOT be supplied.

Forms of Tender will be forwarded UPON RECEIPT OF APPLICATION IN WRITING to :—
The City Engineer,
Municipal Buildings, Dale-street, Liverpool.

Tenders must be sealed and enclosed in the official envelopes provided, endorsed in accordance with the instructions given on the form of Tender, and forwarded through the post, addressed to
The Town Clerk,
Municipal Buildings, Liverpool.

Latest time and date for receipt of Tenders, Ten o'clock a.m. on Friday, 1st March, 1929.
WALTER MOON,
Town Clerk.
13th February, 1929. 943

PUBLIC NOTICES

Liverpool Corporation Water-WORKS.
PUMPING MACHINERY.
AUBREY-STREET, LIVERPOOL.
TENDERS are INVITED for the SUPPLY and ERECTION of ELECTRICALLY DRIVEN PUMPING PLANT, consisting of Three Sets of Centrifugal Pumps and Induction Motors, with Automatic Control Gear, at the Aubrey-street Pumping Station, Liverpool. Each set is to be capable of pumping 2500 gallons per minute, against a total head of 110ft.

Copies of the specification and form of Tender can be obtained from Mr. J. H. Davidson, Water Engineer, 55, Dale-street, Liverpool, upon payment of the sum of Two Guineas, which amount will be refunded upon receipt of a bona fide Tender.

The Water Committee do not bind themselves to accept the lowest or any other Tender.
WALTER MOON,
Town Clerk.
Municipal Buildings, Liverpool, February, 1929. 941

City of Sheffield.
ELECTRIC SUPPLY DEPARTMENT.
NEW ELECTRICITY GENERATING STATION.
The Electric Supply Committee invite TENDERS as follows for WORKS and PLANT required in connection with the building and equipment of a New Electricity Generating Station at Blackburn Meadows Sheffield :—
SPECIFICATION B.M. 64.—Buildings and Civil Engineering Works and Constructional Steel Work.
SPECIFICATION B.M. 66.—Transformers.
SPECIFICATION B.M. 69.—Pipe Work and Valves.
SPECIFICATION B.M. 71.—E.H.T. 3-Phase Switchgear.
SPECIFICATION B.M. 74.—Battery Shunting Locomotive and Accessories.

Contractors desiring to submit Tenders may see the drawings and obtain the separate specifications and forms of Tender at these offices on and after Saturday, February 16th, 1929, on making a deposit of £3 3s. in respect of each specification, which sum will be refunded on receipt of a bona fide Tender. Additional copies of the specification may be purchased at a cost of 10s. 6d. per copy.

Any person or firm sending in a Tender will be required to add a schedule to such Tender, stating the names of the various classes of labour which he or they intend to employ, together with the place where such labour will be employed, and the rates of wages, hours of labour and conditions of employment to be paid and observed in respect of each class of labour, all of which as shown in such schedule shall comply with the City Council's form of clauses respecting wages, hours and conditions of labour and prohibition against assigning and sub-letting.

Tenders, which must be made out on the official Tender form, to be delivered at these offices (enclosed in the official envelope provided) not later than Noon on Thursday, March 14th, 1929.

The Committee do not bind themselves to accept the lowest or any Tender.
S. E. FEDDEN, M. Inst. C.E.,
General Manager and Engineer.
Commercial-street, Sheffield. 989

The Bengal and North-Western RAILWAY COMPANY, LIMITED.
The Directors are prepared to receive TENDERS for the SUPPLY of :—
RED LEAD, DRY, 50 TONS.
WHITE LEAD, DRY, 40 TONS.
COPPER PIPES, 56 CWT.
COPPER RODS, 50 CWT.
TIN INGOTS, 8 TONS.
As per specifications to be seen at the Company's Offices.

Tenders, addressed to the undersigned and marked "Tender for Red and White Lead," or as the case may be, with name of firm tendering, to be lodged not later than Noon on Tuesday, the 26th day of February, 1929.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.
By Order of the Board,
W. B. IZAT,
Managing Director.
237, Gresham House, Old Broad-street, London, E.C. 2, 8/2/1929. 944

The Salisbury Electric Light AND SUPPLY COMPANY, LIMITED.
The above Company has the following PLANT FOR DISPOSAL :—
One 95 Horse-power Electric Lighting Type Crossley Gas Engine with Compressor and Sundries.
Suction Gas Plant and Accessories to suit above Engine.
Dynamo, 550 volts, 91 amps.
Motor Generator, 500 volts, 100 amps., to 100/160 volts, 250 amps.
Switchboards and Sundries.
All plant modern make and in very good condition.
Price £600 for the lot as it stands or near offer.
Can be seen by appointment if desired.
Communications and offers to be addressed to the MANAGER, 27, Market-place, Salisbury. 952

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SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, Competent ENGINEER for New Factory in the Midlands. Must be experienced in supervision of Power-house. Electrical Maintenance and Workshop Machinery Maintenance Departments. Permanency to first-class man. State age, experience, salary required.—Write, MANAGER, Pirelli Ltd., Burton-on-Trent. 961 A

WANTED, POWER-HOUSE ENGINEER, Experienced in supervision of Water-tube Boilers, Pumping Plant, Air Compressors, &c. Permanency to first-class man. State age, experience, salary required.—Write, MANAGER, Pirelli Ltd., Burton-on-Trent. 962 A

WANTED, ENGINEER, Used to Maintenance of Machinery and Plant. Must have Millwright's, Drawing-office and Costing experience. Permanency to first-class man. State age, qualifications, salary required.—Write, MANAGER, Pirelli Ltd., Burton-on-Trent. 963 A

WANTED, ENGINEER SALESMAN for Important firm in London manufacturing Centrifugal Machinery for Chemical Industries. Sales and engineering experience essential. Good prospects for the right man. Age 28 to 32.—Address, giving full particulars of training, experience and salary required 966, The Engineer Office. 966 A

AN ENGINEERING FIRM REQUIRES GENTLEMAN as whole-time REPRESENTATIVE in London area. Payment by results. Good existing business connection. Excellent prospect.—Address, 975, The Engineer Office. 975 A

ASSISTANT WORKS MANAGER REQUIRED; Electrical experience essential and full knowledge latest practice and production methods.—Apply, with full particulars and salary required, to the SECRETARY, Lancashire Dynamo and Motor Co., Ltd., Trafford Park, Manchester. 986 A

CHIEF DRAUGHTSMAN REQUIRED by Manufacturing Firm in the Midlands. The applicant should have experience in the design of Automatic Machinery, Jigs and Tools, and Plant Lay-out. Apply, stating experience, age, and salary required.—Address, P5513, The Engineer Office. P5513 A

DRAUGHTSMAN, About 30 Years, with Good Mechanical Experience. Also JUNIOR, used to Boiler Details. Give full particulars.—Address, 1010, The Engineer Office. 1010 A

DIESEL ENGINE TESTING.—VACANCY for Competent young ENGINEER in Testing Department.—Reply, giving details of previous experience and technical training, age, salary expected, and when free, J. and H. McLAREN, Ltd., Engineers, Leeds. 927 A

DIVER.—PNEUMATIC WELL SINKING FOREMAN REQUIRED for Bridge Foundation Sinking by Air Lock. Must be capable of taking full charge.—Address, 956, The Engineer Office. 956 A

ENGINEERS REQUIRED FOR DESIGNING AND ESTIMATING Heavy Duty Cranes and Machinery, Hydraulic Regulating Gates and Movable Bridges. Must have good technical training and experience along these lines, and ability to handle such engineering work to completion on own initiative with capacity for advancement. Not over 35 years of age. Apply, giving full personal particulars, salary expected, also training and experience, outlining exactly duties performed, to DOMINION BRIDGE COMPANY, Limited, Box 4016, Montreal, Canada. 953 A

FITTER REQUIRED for Small Machine Assembly and Repair, such as Typewriters, Adding Machines. Good knowledge German essential.—Address, P5504, The Engineer Office. P5504 A

FITTER REQUIRED for Bench Work, Small Machine Assembly, and Repair, preferably with knowledge of Sewing Machines.—Address, P5505, The Engineer Office. P5505 A

FAN ENGINEERING ASSISTANTS WANTED for London and Manchester offices of well-known Firm of Fan Makers. Applicants should have had sound D.O. training in all classes of fan work.—Address applications, giving full details of experience, age, salary, &c., 993, The Engineer Office. 993 A

RATEFIXERS for Machine Shop REQUIRED for Time Study on High-grade Production. Only men conversant with cutting speeds and feeds and general shop experience entertained.—Address, giving full particulars of experience, age, and salary required, 968, The Engineer Office. 968 A

SALES ENGINEER REQUIRED, 25-35 Years. Single. To sell Lubrication and Filtration Systems. Salary £20 per month plus 5 per cent. commission on Sales. —Address, giving full personal details, to 1011, The Engineer Office. 1011 A

WANTED, a Smart Young DRAUGHTSMAN, Preferably with experience in Steam Wagon Detail design. Only quick reliable men need apply.—Address, 967, The Engineer Office. 967 A

WANTED, Experienced CHIEF DRAUGHTSMAN for Supervising Drawing-office of 8/10 men, preferably man with General and Machine Tool experience, able to make calculations and assist head of maintenance department. Permanency to first-class man. State age, qualifications, salary required.—Write, MANAGER, Pirelli Ltd., Burton-on-Trent. 964 A

WANTED, JUNIOR DESIGNER DRAUGHTSMAN with technical education, for Experimental Apparatus and Small Machinery. Salary about £200, but depending on qualifications.—Apply in writing, stating age, qualifications, and salary required, to the DIRECTOR, Research Laboratories of the G.E.C., Ltd., Wembley. 987 A

WANTED, Thoroughly Capable DRAUGHTSMAN for old-established business in the Midlands manufacturing special high-class machines. Must have had practical shop experience with machine tools and experience in staff management. Age about 35. Good prospects.—Apply by letter only, giving age, full details of experience, and salary required, to "ENGINEER," c/o Wykes and Co., Chartered Accountants, Leicester. P5447 A

DESIGNER and CHIEF DRAUGHTSMAN REQUIRED to Take Charge of Drawing-office in Works manufacturing Accurate Machinery. Must have had considerable Machine Shop experience.—Address, stating age, experience, and salary required, 992, The Engineer Office. 992 A

DESIGNERS, with Experience in the Design of the latest type Heavy Motor Vehicle Chassis and Details, REQUIRED by a large firm in the South of England. Good positions to the right men.—Apply by letter, giving full particulars of experience, age, and salary required, &c., 750, The Engineer Office. 750 A

DETAILING DRAUGHTSMAN REQUIRED for Constructional Steel Works in North London. Must be able to prepare shop drawings with minimum supervision and be familiar with Steel Frame (1909 Act) Buildings.—Address, stating age, experience, and salary required, P5473, The Engineer Office. P5473 A

DRAUGHTSMAN, Mechanical or Electrical. Experience of Transformer or Electric Control Gear work an advantage.—Address, giving particulars of experience, age, and salary required, 831, The Engineer Office. 831 A

DRAUGHTSMAN (Not Junior) for Pumping Machinery, Reciprocating and/or Centrifugal.—Address, stating age, experience, salary required, 857, The Engineer Office. 857 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN for Heavy Oil Engines, Land Type.—Address full particulars, age, and salary required, 858, The Engineer Office. 858 A

DRAUGHTSMEN REQUIRED for Electric Furnace design. One with good all-round electrical knowledge and one mechanical. State qualifications and salary required.—Address, 996, The Engineer Office. 996 A

DRAUGHTSMAN REQUIRED for Machine Tool Works, Midlands. Accustomed to Lathes, Shaper and Milling Machine. State age, salary, and full experience.—Address, 995, The Engineer Office. 995 A

DRAUGHTSMAN REQUIRED, Used to Structural Work, Elevating, Conveying and Crushing Machinery.—Address, stating details of experience, previous appointments, age, and salary, 998, The Engineer Office. 998 A

DRAUGHTSMAN, Senior, with First-class Experience of Power Transformers.—Apply, stating age, experience, and salary required, to MANAGER, Drawing-offices, B.T.H. Co., Ltd., Rugby. 819 A

DRAUGHTSMEN, STRUCTURAL and MECHANICAL, first class, REQUIRED in London district; must be fully experienced in Material-handling Plant Contracts.—Write, stating experience, age, and salary required, to Box 299, Sells' Advertising Offices, Fleet-street, E.C. 4. 896 A

JIG and TOOL DESIGNER REQUIRED in Works situated about 30 miles south of London. Only those who have had experience on Automatic Machinery and similar work need apply.—Address, stating age, experience, and salary required, 991, The Engineer Office. 991 A

JUNIOR DRAUGHTSMAN REQUIRED by a Firm of Constructional Engineers in London.—Address, stating age, experience, and salary required, P5472, The Engineer Office. P5472 A

FULLY QUALIFIED DRAUGHTSMAN REQUIRED. Experience in Motor Car Design. Applicants must state experience, age, and salary required.—Address, 946, The Engineer Office. 946 A

JUNIOR DRAUGHTSMAN, 20-26 Years, Able to take out quantities and willing to specialise in Lattice Tower designing; preference given to man with some experience in Tower Design. No other work handled.—Apply, stating wages required, to PAINTER BROTHERS, Hereford. Good prospects of advancement. 951 A

MALE TRACER or JUNIOR DRAUGHTSMAN REQUIRED by Engineers in Midlands; permanency to right man. State age, experience, and salary required.—Address, 950, The Engineer Office. 950 A

MESSRS. RANSOMES and RAPIER, Ltd., REQUIRE an ASSISTANT FOREMAN of about 30 years of age for their Girder Shop. Applicants must have had experience in Crane and similar Structural Steel Work and should state full particulars of their career when applying to WATERSIDE WORKS, Ipswich. 999 A

SENIOR HEATING DRAUGHTSMAN REQUIRED. Must be capable of handling inquiries and contracts from start to finish. One with initiative, able to take charge of D.O. as and when required.—Address, 997, The Engineer Office. 997 A

TRACER REQUIRED; Must be Neat, Quick and accurate and used to pipe work.—Write, stating age, experience, and salary required, to "P. Q.," c/o Street's, 6, Gracechurch-street, E.C. 3. 969 A

WANTED, FOREMAN MILLWRIGHT (Glasgow district); experience in Electric Motors, Lighting, &c., essential. Would be an advantage if experienced in modern methods of installing machinery.—Address, "MILLWRIGHT," Wm. Porteous and Co., Glasgow. P5493 A

WANTED, PRODUCTION FOREMAN for Constructional Steel Works. Applicants must be well skilled in all kinds of large Circular and Conical Work, be used to Electric and Oxy-acetylene Welding, and of forceful personality.—Address, giving full particulars of experience, age, and salary required, 948, The Engineer Office. 948 A

FOREMAN ENGINEER WANTED, to Take Charge of Plant and Machinery (Electrical and Steam) for London Preserve and Confectionery Factory. One with similar trade experience preferred.—Address, P5496, The Engineer Office. P5496 A

SITUATIONS WANTED

A SECRETARY SHORTHAND TYPIST, Some Years' engineering experience, all-round office routine and good knowledge German, SEEKS really RESPONSIBLE POST.—Address, P5429, The Engineer Office. P5429 B

A MECHANICAL and STRUCTURAL ENGINEER (33), M.Eng., A.M.I. Mech. E., holding responsible position, DESIRES CHANGE, home or abroad. First-class designer and draughtsman of proved inventive ability. Experienced in workshops, lay-out of plant, control of men and as travelling representative. Specialised knowledge of steam plant, auxiliaries and scientific testing of power plant.—Address, P5497, The Engineer Office. P5497 B

BRASSFOUNDERS AND FINISHERS.—WORKS MANAGER (47) SEEKS APPOINTMENT; thoroughly versed modern foundry and machine shop practice, latest tools and labour-saving appliances for manufacture of steamship and plumbers' fittings.—Address, "METALS," 29, Kyrwicks-lane, Highgate, Birmingham. P5501 B

CONTRACT Terminating Abroad. ENGINEER (41) REQUIRES POST. Experienced mech., constructional, contractors, railway works, comm, works, and dept. management.—Address, P5273, The Engineer Office. P5373 B

COMMERCIAL ENGINEER, With Good All-round Training, SEEKS CHANGE. Much experience in works and sales organisation, costing, estimates, &c. Strong on the commercial side. Accustomed to controlling works and staff. Has occupied managerial positions.—Address, P5506, The Engineer Office. P5506 B

DRAUGHTSMAN (26), G.I. Mech. E., 5 Years' Shops, 6 years' D.O. experience, rotary and reciprocating air compressors, DESIRES POSITION.—Address, P5500, The Engineer Office. P5500 B

ENG. (28), Highly Qualified, Shop and College, 1st B.O.T. Cert. Exp. D.O. Used to Handling men. ASSISTANT WORKS MANAGER.—Address, P5509, The Engineer Office. P5509 B

ENGINEER (27), A.C.G.I., A.M. Inst. C.E., 4 Years' shops, 5 years' works planning, construction and administrative experience, DESIRES RESPONSIBLE POST with scope.—Address, P5491, The Engineer Office. P5491 B

ENGINEER (29) SEEKS RESPONSIBLE POSITION; public school education, experienced D.O. and assistant engineer, works extensions and maintenance.—BM/LO24, London, W.C. 1. P5449 B

SITUATIONS WANTED (continued)

GENERAL or WORKS MANAGER, M.I. Mech. E., DESIRES CHANGE; successfully controlling engineering works, steel and ironfounders, constructional and electrical work. He has had exceptionally broad experience, covering administration, organisation, commercial, technical and practical, up-to-date modern production and cost methods, both repetition and non-repetition, and big enough to take sole responsibility and produce dividend-paying results.—Address, P5508, The Engineer Office. P5508 B

TWO Experienced ESTIMATING and RATE-FIXING ENGINEERS (machine and fitting) SEEK POST with a view to introducing the bonus or piecework system and latest methods of production.—Address, P5492, The Engineer Office. P5492 B

WILL FIRM REQUIRING REPRESENTATION among the Engineers, Shipyards, &c., of North England and Scotland, by a well-known experienced Traveller of high standing, please communicate.—Address, P5462, The Engineer Office. P5462 B

WORKS MANAGER DESIRES POSITION; Wide experience, first-class record as organiser and production expert, experienced in general, electrical and high-grade mass production.—Address, P5507, The Engineer Office. P5507 B

YOUNG ENGINEER (G. I. Mech. E.), SEEKS JOB, 5 years' workshop experience.—Address, P5517, The Engineer Office. P5517 B

EDUCATIONAL

Correspondence Courses
OF PREPARATION FOR THE
Examinations of the
INST. OF CIVIL ENGINEERS,
INST. OF MECHANICAL ENGRS.,
INST. OF STRUCTURAL ENGRS.,
UNIVERSITY OF LONDON, &c.,
are personally conducted by
Mr. Trevor W. Phillips,
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For continuation of For Sale Advertisements see page 4.

A Seven-Day Journal

Cross-Channel Traffic Working.

IN a paper delivered at an ordinary meeting of the Institute of Transport on Monday evening last, Colonel Gilbert S. Szlumper, the assistant general manager of the Southern Railway, and formerly that company's docks and marine manager, dealt with cross-Channel traffic. Speaking of train ferries, he said it must not be overlooked that owing to the Customs examinations consignments had to be disturbed and reloaded. There was a probability that any special ferry wagons, working to some of the remote corners of Europe, would find a permanent home there. British ordinary wagons would not be acceptable on the Continent, and the British structure gauge would not take continental wagons, and the alternative would be that every wagon load, inwards and outwards, would have to be transhipped at the port. Furthermore, four cargo boats could be built for the price of one train ferry vessel, without taking into account the necessary port works. On the subject of a Channel tunnel, the speaker asked to be allowed to state with emphasis that he was offering only his personal opinions. On the lowest estimate of £30,000,000 a gross revenue of £3,000,000 would be requisite. An enormous increase in traffic would be necessary, if attractive fares and rates were to be adhered to, to provide a return on the capital to be expended. It must not, he said, be forgotten, when making any estimate of traffic, that many passengers had a horror of being in a tunnel, and would still prefer to use the cross-Channel vessels. Much of the traffic which comes from France through other ports than Boulogne or Calais would not stand the cost of the extra rail haulage to take it to the tunnel route. Some interesting details were given in the paper as to oil fuel on cross-Channel boats. Actual comparative running showed that the consumption of oil as against coal was as 3 is to 5. Hence the use of oil was economical so long as its cost per ton was not more than double that of coal. At present the prices were much in favour of oil. Superheating appeared to be a long time establishing itself firmly in marine practice. The question had just been before the author in connection with new vessels, and he found that to introduce superheat of 200 deg. Fah. at the boilers would add about 3½ per cent. to the cost of a boat, but would lessen the fuel consumption by 7½ per cent., giving a saving of between £800 and £900 a year. That economy would, however, be more than absorbed by counter expenses, *e.g.*, interest on additional capital cost, wages of the extra engineer *personnel* required, and the provision of plant to furnish pure water.

The Lochaber Hydro-Electric Power Scheme.

ON Saturday, February 9th, the last shot, opening up the 15-mile tunnel through the Ben Nevis range, between Fort William and the valve shaft at Lochtreig, was fired. The scheme, which has been undertaken on behalf of the British Aluminium Company, at a cost of seven million pounds, includes a new town, a power-house, factory, dams, conduits, and access railways. The main purpose of the undertaking is the manufacture of aluminium, and it is expected that employment will be found for several thousand workmen. The main tunnel driven at Lochaber was begun in the summer of 1926, but the work during that year was severely hampered by strikes and other labour troubles, and the actual driving of the tunnel may be said to have taken about two years. Although this lengthy underground waterway has now become an accomplished fact, about half the tunnel still remains to be lined with concrete. Besides the tunnel, there are included in the Lochaber Power Scheme twelve shafts, intake dams, conduits, pipe lines, a power-house, a factory, a tail-race, and 23 miles of access railways. The tunnel is believed to be the largest of its kind in the world. The contract is being carried through by Balfour, Beatty and Co., Ltd., who are also responsible for the Grampian hydro-electric scheme. The consulting engineers are G. S. Meik and Buchanan.

King's College, London.

IN September this year the centenary will occur of the foundation of King's College, London. The College, together with University College—formerly its rival—and some thirty other educational institutions concerned with higher education in the Metropolis, now constitutes the "University of London." In connection with its centenary King's College last year issued an appeal for £350,000 to enlarge its accommodation and to provide certain endowments. Of the total sum about £100,000 is needed to endow special chairs and studentships in physics, physical chemistry, electrical engineering and physiology. A sum of £125,000 is required for rebuilding the south-east block of the College in order to provide new accommodation for the chemistry and other departments. On Tuesday the Lord Mayor of London gave a luncheon at the Mansion House in support of the College's Centenary Appeal Fund. He recalled the fact that University College and King's College were pioneers in the modern development of university educational facilities in England, and mentioned that King's College had on its roll of former professors Wheatstone and Clerk Maxwell in physics, Lyell in geology, and Lister in surgery. The Bishop of Gloucester, a former principal of the College, stated that it had suffered much from poverty. The Duke of Wellington, one of its great promoters, had obtained from his fellow peers large subscriptions to its building fund and hoped to obtain equally large subscriptions to its endowment fund. In the meantime, however, he became an active supporter of the Catholic emancipation movement, and in so doing he antagonised many of those to whom he was looking for financial help. The Duke was actually embroiled in a duel with Lord Winchelsea over the question. The expected subscription did not come in and King's College started its career very inadequately endowed. The Bishop also mentioned that the College was the first in England to have a physics laboratory and was also the pioneer in the establishment of a bateriological laboratory.

Power from Warm Water.

A FEW months ago Monsieur Georges Claude visited Cuba with a view to selecting a site for the practical demonstration of the plant which has been in operation at the Ougrée-Marihaye works in Belgium for the production of energy from the extremes of sea temperature. In a note to the Académie des Sciences Monsieur Claude states that he has found a suitable site in the Matanzas Bay, about 60 miles from Havana. A partially flexible corrugated tube will be immersed in the sea to a depth of 600 m. at a distance of 1500 m. from the shore, where the water temperature is from 10 deg. to 11 deg. Cent., is being made in France. The tube will have a diameter of 2 m. and a total length of 2000 m. It is expected that the immersion of the tube will take place in June, and the results will then show whether the promoters will be justified in laying down a 12,000-kW plant which is to be the first step towards the industrial utilisation of the Claude-Boucherot system. Both inventors have complete confidence in the economy of their method of power production. Monsieur Boucherot going so far as to affirm that it will be possible to produce ice commercially in sufficient quantities to change the conditions of existence in tropical climates. In our issue of November 26th, 1926, we discussed the principle of Messieurs Claude and Boucherot's proposal.

St. Paul's Bridge.

ON Tuesday the Corporation of London (Bridge) Bill was rejected in the House of Commons by 81 votes to 62. The Bill concerned the St. Paul's Bridge scheme, and its object was to obtain an extension of two years in the time originally allowed by Parliament for the construction of the bridge. The Corporation has already incurred an expenditure of £1,265,000 on the scheme, but, as is well known, the construction of the bridge has excited so much opposition in many different quarters that, although plans for the bridge have been prepared and property on its proposed site has been purchased, the Corporation has not found it possible or desirable to proceed with the scheme. The period originally allowed for the execution of the work having expired, the Corporation desired an additional two years for further consideration of the problem in all its bearings. It undertook if its request for an extension of time were granted not to begin building operations within the period without obtaining renewed Parliamentary sanction to its proposals. Even so there was a manifest desire on the part of many members in the House to kill the proposal once and for all. Whether the scheme is in actual fact now to be regarded as dead beyond hope of resuscitation it is hard to say. According to the supporters of the defeated Bill failure to carry out the scheme will involve the loss of half the sum which, as stated above, has already been spent on it.

A Lesson in Industrial Economics.

A STRIKING little lesson in industrial economics was contained in the remarks of the chairman, Mr. H. Bendixon, at the general meeting last week of the Skefko Ball Bearing Company, Ltd. Taking the selling price of high-grade ball and roller bearings in 1913 at 100 the price to-day was, he said, about 60 as compared with a figure of probably 150 for machining in general. He attributed this remarkable fact to the adoption of improved methods and machinery in the ball bearing industry. The progress effected in that direction was, he said, such that at the company's Luton works the production of bearings per man per day taken as represented by unity in 1913 rose to 1·92 in 1924 and to 4·90 in 1928. That very great increase in production per man per day had largely offset the higher costs of labour, material, rates and taxes and so forth. In addition, the average hourly earnings of the workers in the Luton factory were higher than they had ever been since 1924, while the number of people employed was greater than at any previous period except for a short time in 1925. Plans, he added, were in hand for increasing the production of bearings at Luton by about 40 per cent. It is not perhaps surprising to learn that the company's net profits have also shown a noteworthy increase, namely, from £28,000 odd in 1927 to nearly £41,000 in 1928. We may, perhaps, add that in April, 1918, we published a description of the Skefko Company's Luton factory and of its methods of manufacture as then in use. Two apparently innocent external views of the buildings were held by the Government Press Censor to provide a clue to a possible target for enemy airmen, and, as a consequence, we were forbidden to send outside the United Kingdom copies of the issue in which they appeared.

The Melchett-Turner Scheme.

ON Wednesday last the Federation of British Industries and the National Confederation of Employers' Organisations sent a joint invitation to the General Council of the Trades Union Congress to meet their representatives. The subscribers to the letter say: "At this conference they could explain the difficulties which stand in the way of consultation with your Council through a National Industrial Council, as proposed in the 'Melchett-Turner' report of July 4th last. The Confederation and the Federation are, as you know, distinct and separate bodies—the Confederation dealing with Labour questions and the Federation with Economic and Commercial questions—and, as the result of the most careful consideration of the interim report, each organisation within its own province has reached the conclusion that it cannot accept the report. Throughout the consideration of the whole matter, however, the Confederation and the Federation have been conscious of the importance of doing everything in their power to further the promotion of industrial peace in British industry, and the cordial invitation extended to your General Council to meet representatives of the Confederation and of the Federation is made in the hope that the discussions will be such as to help forward a better mutual understanding in industry generally."

A New Zealand Motor Liner.

THE new twin-screw motor liner "Rangitiki," which left London yesterday, and leaves Southampton to-day on her maiden voyage to New Zealand, *viâ* the Panama Canal, is the first of three 17,500-ton ships which have been or are being built by John Brown and Co., Ltd., at Clydebank, for the mail service of the New Zealand Shipping Company. The "Rangitiki" has a length of 530ft., with a beam of 70ft. 3in., and a depth of 43ft. 3in. She is equipped to carry 100 first-class passengers and eighty second-class, together with about 400 third-class passengers. Very comfortable cabin and public room accommodation has been provided. There is also provision for ordinary and refrigerated cargo, the insulated space amounting to close upon 425,000 cubic feet. The main propelling machinery comprises a twin-screw arrangement of single-acting two-stroke Brown-Sulzer engines. Each engine has five cylinders, with a bore of 900 millimetres, and a stroke of 1600 millimetres, and the scavenge pumps are directly driven from the engines. These units are noteworthy as having larger cylinder diameters than any oil engines hitherto built for ship use. The total output is from 8000 to 10,000 S.H.P. when the engines are running at about 90 r.p.m., and the machinery is designed to give the ship a sea speed of about 15 knots. On the way round from the Clyde to London heavy weather was encountered, but although the ship was in ballast she proved herself, in the view of the captain, a very steady ship. During the year the two other liners will be put into service.

The Late Sir John Cowan.

IT is with regret that we have to record the death of Sir John Cowan, the chairman and managing director of Redpath, Brown and Co., Ltd., of Edinburgh. Sir John was in his eighty-fifth year, and died last week at his home in Edinburgh, after an illness extending over some months. He was born in Jamaica, and received his education at the Edinburgh Institution and at Edinburgh University. In 1860 he joined the firm of Redpath, Brown and Co., in which his uncle was then a partner. Six years later he was made a partner himself, and thereafter he was instrumental in guiding the very successful development of the firm. The business of Redpath, Brown and Co. dates back to 1802, when the firm was mainly engaged in the iron and ironmongery trades. The constructional engineering branch was begun in a comparatively small way, with a staff of only twelve men, but to-day the firm employs over 1200 men in its Edinburgh, Glasgow, Manchester and London branches and works. The firm has in force a policy of profit-sharing, and the men are encouraged to invest their savings in the firm. At the diamond jubilee of Sir John's connection with the firm, which took place in 1920, he was complimented by the men on his enlightened control of the firm and upon the cordial relations which had always existed between the firm and its workers. Sir John Cowan took a very prominent part in the civic life of Edinburgh, and in 1876 joined the Edinburgh Merchant Company, becoming its Master during the years 1901-1903. Later he was the chairman of the Edinburgh Chamber of Commerce for a short period. He was also a Deputy Lieutenant of the City of Edinburgh and an LL.D. of Edinburgh University.

The London Power Company.

No. I.

THE first effective step towards putting the electricity supply of London on a rational basis was taken in the year 1920 when the Electricity Commissioners delimited an area known as the London and Home Counties Electricity District, which should be subject to unified control. The idea was that the whole of the generating stations in the area should be taken over by a "Joint Electricity Authority," which would shut down the uneconomical ones, operate and develop the efficient ones to the best advantage, and supply current in bulk to the existing distributors. The parties mainly interested in such an arrangement fell into three groups: the companies, ten of which associated themselves for common action under the name of the London Electricity Joint Committee (1920), Ltd.; the municipalities, which founded the Conference of Local Authorities for a similar purpose; and the London County Council. The latter, besides representing the interests of the consumers and ratepayers generally, was further concerned on account of the its wiser members also realised that such a body was not qualified to administer so highly technical a business as that of the wholesale generation and distribution of electricity. Various solutions of the problem were proposed, one of the most promising being the formation of two Joint Electricity Committees, which should represent respectively the company and the municipal undertakings in the area. This proposal, however, was declared *ultra vires* by the Law Courts, and the whole matter was once more thrown into the melting pot. Negotiations, however, proceeded between the companies and the County Council, the attitude of which had throughout shown a sincere desire to arrive at a business-like solution, equitable as between the companies and the public and capable of giving London the unified service so essential to a proper development of electricity. Finally, an agreement was arrived at and the London and Home Counties Joint Electricity Authority was established by the Commissioners on July 29th, 1926. Two days later Parliament passed the two London Electricity Acts which implemented the agreement. The purport of these Acts is generally known. The first authorised four companies not members of the ten-company group to tures or debenture stock or other securities issued for the purposes of this Act any rate of interest exceeding six pounds per centum per annum." Its real function is to generate electricity, for its component companies, in the cheapest and most efficient manner, benefiting them by a supply at a lower price than that at which they could generate for themselves in their own individual and unco-ordinated plants. Nor are the benefits of unification of supply to be to the advantage of the distributing companies alone. They, in their turn, must pass them on to the public, in the way of reduced charges, for dividends are restricted up to 1931 to the dividend paid in 1922, or 10 per cent. on old capital and 7 per cent. on reserves capitalised, and from 1931 to 7 per cent. on all ordinary capital, and any surplus remaining after the payment of the "standard" dividend has to be applied as to six-eighths to the reduction of the price of electricity, one-eighth to shareholders, and one-eighth may be applied to a co-partnership fund.

The area in the County of London over which electricity is supplied by the London Power Company is shown in Fig. 1. It extends from the residential quarters of the West, right through the City and business quarters to the dock lands in the East of

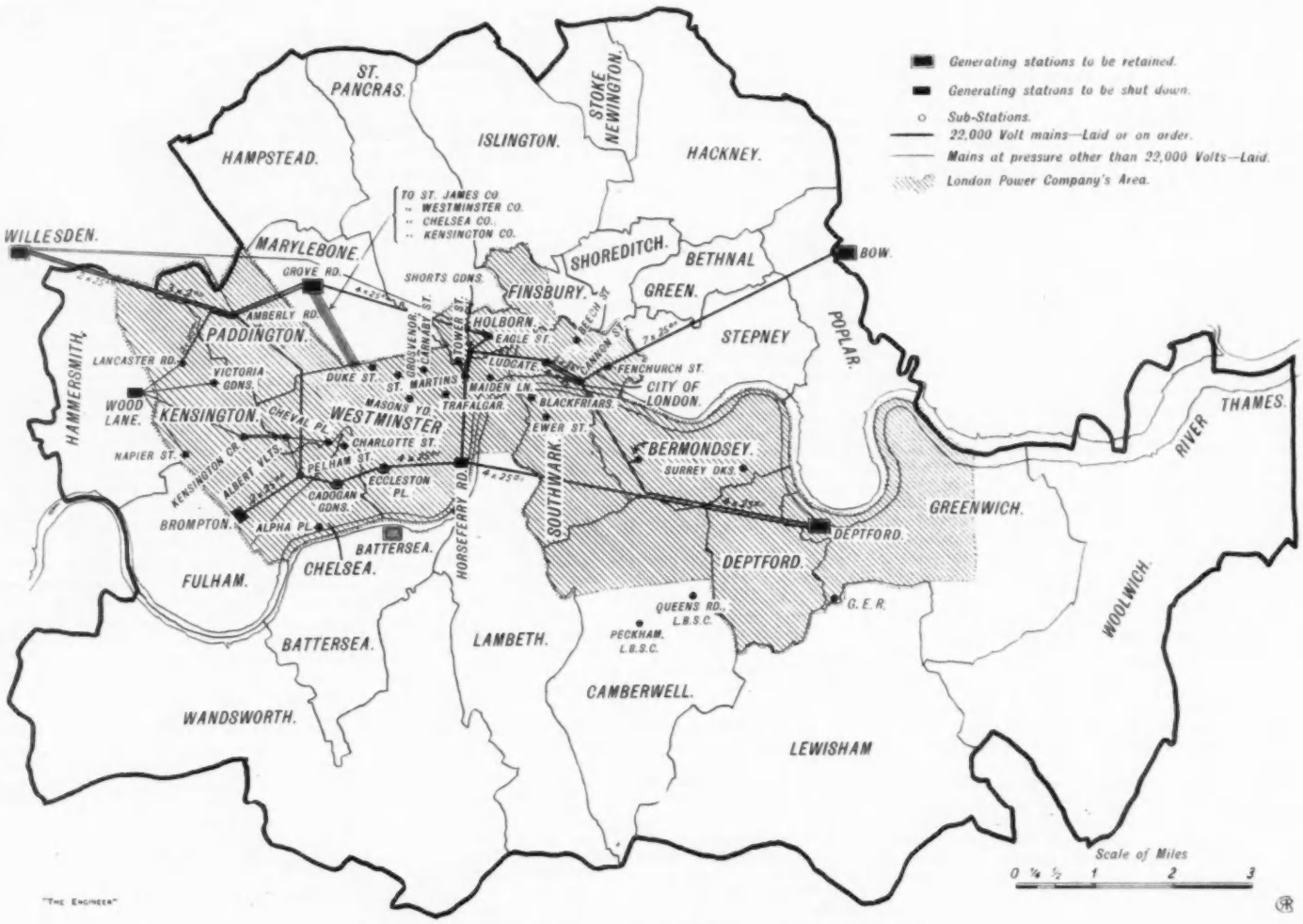


FIG. 1—THE AREA SUPPLIED BY THE LONDON POWER COMPANY

powers it possessed to buy out all the company undertakings in 1931 or at intervals of ten years thereafter. The company group, above mentioned, comprised the Brompton and Kensington Electricity Supply Company, Ltd., the Central Electric Supply Company, Ltd., the Charing Cross Electricity Supply Company, Ltd., the Kensington and Knightsbridge Electric Lighting Company, Ltd., the London Electric Supply Corporation, Ltd., the Metropolitan Electric Supply Company, Ltd., the Notting Hill Electric Lighting Company, Ltd., the St. James and Pall Mall Electric Light Company, Ltd., and the Westminster Electric Supply Corporation, Ltd.

It says much for the good sense of the engineers of the three parties that they had no difficulty in arriving at agreement on a technical scheme for the unification of the London electricity supply. But nothing could reconcile the views of the parties where financial and political matters were concerned. The companies had the most profound distrust of any scheme which would have put the capital of their shareholders at the mercy of popularly elected bodies without responsibility towards the owners of it. The municipalities, for their part, would not agree to any proposals which, in their opinion, would have put the companies in a position where they would be inamenable to the pressure of public opinion. The London County Council, again, was not prepared to relinquish its powers of purchase unconditionally, although it was by no means disposed to incur the vast financial obligations which purchase would have entailed, and probably amalgamate. The second Act authorised the London Electricity Joint Committee (1920) Ltd. to take over the whole of the power stations and generating machinery of its ten constituent companies and to supply current in bulk to their former owners, who would henceforth act as distributors and retailers only of electricity. It also has power, with the consent of the Electricity Commissioners, to supply electricity to the Joint Electricity Authority or to any other authorised undertakers whose areas of supply adjoin that of the company. The Act also gave power to amalgamate the whole of the undertakings, with the consent of the Electricity Commissioners. The tenure of the London companies was extended to 1971, when their undertakings will be transferred to the Joint Electricity Authority. At that date their assets, which existed at the time when the Acts were passed, will be transferred free of cost, and subsequent capital expenditure will be reimbursed in so far as it is not amortised by statutory sinking funds. The Acts further provided that the prices charged for electricity should be regulated on a sliding scale, diminishing in proportion to the dividends paid by the companies.

The London Power Company is not a profit-earning company. It is precluded from distributing any dividend to its shareholders, other than the fixed interest of 6 per cent. on its initial capital under Sec. 24 of the London Electricity (No. 2) Act, 1925, which reads:—"The Company shall not without the consent of the Commissioners attach to any debenLondon. In the year 1920, before the association of the ten companies, this area was served by no less than thirteen independent generating stations. The small size of the majority of them will be evident from the following Table I., which gives their output for the year ending December 31st, 1919:—

TABLE I.—*Output of Generating Stations in the Present London Power Company's Area, for the Year Ending December 31st, 1919.*

Name of station.	Units generated.
Alpha-place	2,850,000
Amberley-road	—
Bow	41,178,630
Carnaby-street	395,545
Cheval-place	195,000
Davies-street	55,230
Deptford East	48,000,000
Eccleston-place	116,740
Grove-road	38,280,000
Horseferry-road	12,138,000
Richmond-road	4,399,000
Willesden	39,320,000
Wood-lane	10,478,000

The engineering policy determined on by the ten companies in 1920 and pursued by the London Power Company since its formation, has been to interconnect the main generating stations and to transmit electricity at 22,000 volts pressure to the most convenient distributing centres; to improve and extend the more efficient and better-situated generating stations; to shut down the smaller and less efficient stations as opportunities occurred; to erect capital stations with modern units of large capacity; and to

establish a central system of control so that the load on the whole area could be handled in the most economical manner, and that any emergency on the system could be dealt with promptly and effectively. In accordance with this policy, the Davies-street station of the Westminster Company was shut down in 1921; the Eccleston-place station of the same company, and the Carnaby-street station of the St. James Company were shut down in 1922; in 1923 the Cheval-place station of the Kensington Company was removed from the list of effectives; while the London Power Company closed the Amberley-road station in 1926, the Horseferry-road station in 1927, the Alpha-place, Richmond-road and Wood-lane stations in 1928. The London Power Company is thus retaining only the four large stations at Bow, Deptford East, Grove-road, and Willesden from among all those which formerly served the area. A new capital station, which will be known as Deptford West, is in course of construction by the company, and another will shortly be commenced at Battersea.

The map, reproduced in Fig. 1, shows the positions of the capital stations with reference to the area to be served, and the main interconnecting system of 22,000-volt cables. It will be noticed that the Willesden, Grove-road, and Bow stations are all outside the borders of the London Power Company's territory, and Battersea will have the same peculiarity. The conditions of London are, however, such that large stations would not be tolerable in more central positions, even if coal and water supplies could be easily obtained. The Deptford and Battersea sites are the best favoured by Nature as water-borne coal is available, and the whole of the river Thames is at the doors for condensing purposes. Bow has a fair supply of condensing water from the river Lea, but Grove-road and Willesden, being only served by small canals, have to depend on cooling towers. The river Thames divides the London Power Company's area into two parts of approximately equal size, although the part north of the river, containing as it does the City and West End, is of the greater importance. The rate at which the load is growing in the northern part is shown graphically in Fig. 2. The maximum load

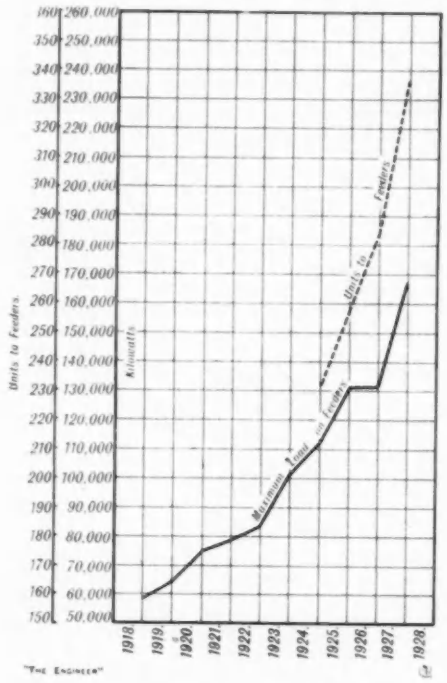


FIG. 2—NORTH LONDON. GROWTH OF LOAD

on the feeders has grown from about 58,000 kW at the beginning of 1919 to 168,000 kW at the end of 1927. The number of units delivered to the feeders has increased from 231,000,000 to 380,000,000 in the last three years. The southern part of the area is served almost exclusively by the Deptford East station, which is of historical interest as the prototype of all modern stations, Ferranti, the original designer, being the first engineer to recognise that a large power station built where land, water and coal were cheaply obtainable could serve a city better than a number of little plants in places where they were a nuisance to themselves and to everybody else. The Deptford plant is now, of course, unrecognisably different from its initial form, but the single-phase generation with which it started has not yet been superseded entirely by the modern three-phase system.

Before discussing further the work of the London Power Company as a whole, we shall give a short account of its several generating stations, as this will enable the reader to form a better idea of the magnitude of the company's operations and of the means at its disposal for serving its customers. We do not propose to describe the stations in detail, but rather to confine our attention to their most interesting features, with special reference to the economy of operation.

(To be continued.)

Atmospheric Pollution in England and Scotland in 1927-1928.

By JOHN B. C. KERSHAW, F.I.C.*

THE annual reports upon air pollution in the thirty English and Scotch towns in which observations are being carried on, are now published by the Department of Scientific and Industrial Research. In the past, there has been considerable delay in the publication of the official figures for the year; but it has been possible recently to obtain a useful survey of the results of the observations from the annual reports of the meteorological department of the county borough of Southport, which contain the monthly means for the various impurities collected in the deposit gauges. As these figures have been compiled by Dr. J. S. Owens, the London Superintendent of the Air Pollution Observations, they may be accepted as quite reliable, and they have been employed for the construction of the tables given in this article.

According to the last published report, thirty towns and cities are now carrying on the observations, and seventy-nine deposit gauges are in use, with eleven automatic filters. These totals show that the area covered by these observations upon atmospheric pollution is extending rapidly. As the present writer was one of the first to urge the necessity for the use of standardised methods of observation, and was a member of the original committee which selected the standard gauge and method for measuring air pollution, and also initiated the work of observation in 1913, he is naturally pleased to record these signs of growth in the importance and extent of the work. It is now possible to compare results for different cities and towns and to state definitely whether the atmosphere of any town is cleaner or dirtier than that of some other town or city of similar size. It is also possible to indicate whether any improvement can be traced in the cleanliness of the atmosphere of any place over a long series of years.

As regards the number of deposit gauges installed in individual towns or cities, Rochdale has increased its number of gauges to thirteen and now heads the list, while London ranks second with twelve; Glasgow third with nine; and of the remaining towns and cities, Salford has four; Birmingham, Edinburgh, Leeds, Leicester, and Newcastle-on-Tyne have each three; Blackburn, Brighton, Huddersfield, and Southport have two each; and the remaining towns only one. It is still noticeable that many of the manufacturing towns of the North, especially in Lancashire and Yorkshire, are taking no part in these observations, and it is quite time that the health authorities of Bolton, Bradford, Bury, Keighley, Oldham, Sheffield, and Wigan—to name only a few—started to record their atmospheric pollution. The public health authorities of the city of Manchester, have been carrying on the observations for some years, and ought now to allow their figures to be published in order that they may be compared with those obtained in other cities of similar size and importance. The number of deposit gauges installed in the cities of Birmingham, Burnley, Liverpool, St. Helens, Stoke-on-Trent, and Wakefield ought also to be increased. One, or at the most two, gauges in the centre of a large manufacturing area will not give a fair average figure for the air pollution of the whole district, since the values obtained will be very inflated.

With these preliminary observations, the result obtained in twenty-five of the thirty cities and towns which were engaged in the investigation of air pollution for the year ending March 31st, 1928, will now be discussed in some detail.

THE LONDON RESULTS.

Table I. gives the London figures for the total of solid matters collected in the gauge at each of the

TABLE I.—*London's Soot and Dust Fall.*

Station.	1925–26.	1926–27.	1927–28.
Meteorological Office	10,106	11,856	11,556
Archbishop's Park	14,352	14,976	13,320
Finsbury Park	8,743	10,080	11,064
Ravenscourt Park	6,881	11,664	8,688
Southwark Park	9,221	10,104	13,008
Victoria Park	8,695	8,244	8,184
Wandsworth Common	7,050	7,416	9,540
Golden-lane	17,255	18,588	23,268
Kew Gardens (1)	—	—	6,864
Kew Gardens (2)	—	—	7,788
Averages for all stations	9,944	11,622	11,328
Average for 8 stations	—	—	12,328

observation stations for the three years 1925–26, 1926–27, and 1927–28, the results being expressed as metric tons per 100 square kilometres. It will be noticed that results from two new observation stations in Kew Gardens are included with the last year's return, and that each of these stations shows, as might be expected, a low deposit of solid matter. The inclusion of these low figures in the average for the London soot and dust fall brings this average slightly below the preceding year's figure; but if the Kew observations are excluded for the purposes of obtaining a more correct comparison, the London average for 1927–28 is considerably higher than that for 1926–27, being 12,328 tons as compared with 11,622 tons.

The London gauges which show increases for 1927–28 are those situated in Finsbury Park, Southwark Park, Wandsworth Common, and Golden-lane, and it is the large increase in the amount of solid deposit in the Golden-lane district which has brought the average for the eight London gauges in the year ending March 31st, 1928, up to 12,328 tons. Since this increase of London's atmospheric pollution is now attracting considerable attention, the figures for the average annual deposit of solid matter collected at all the London stations, since 1915, are given in tabular form below, the results being expressed in this case, as tons per square mile per annum:—

TABLE II.—*London's Soot and Dust Fall from* 1915 *to* 1928.

Year.	Total solids in tons.	Three-year averages.
1915–16	451	
1916–17	427	436
1917–18	431	
1920–21	304	
1921–22	284	296
1922–23	300	
1923–24	286	
1924–25	298	279
1925–26	254	
1926–27	297	
1927–28	315	

The large increase in London's deposit of solid matter in the year 1926–27 was ascribed by the writer to the use of cheap foreign and uncleaned types of coal during the period of the disastrous coal strike in 1926, and this explanation will still hold good for the smaller increase in the solid deposit which characterised the year ending March 31st, 1928. The figures, in his opinion, also indicate that the consumers of bituminous coal for industrial or domestic purposes within the metropolitan area are becoming more careless in their choice of fuel and in the management of their fires, and are producing more smoke and creating a greater amount of atmospheric pollution than in the earlier period 1923–1926.

It is imperative, therefore, that the health authorities of the different London Boroughs and all societies and technical institutions interested in the problems of smoke abatement in London, should take active steps to counteract this retrograde movement, for the losses and inconveniences due to fogs have increased concurrently with the volume of traffic in the streets of the Metropolis, and Londoners this winter have experienced already more than the average number of gloomy days and overhead fogs.

THE GLASGOW RESULTS.

Glasgow is the only other large city in which the soot and dust fall observations have been carried on with a larger number of gauges for a considerable period, and in view of the increase in the London figures it is of interest to submit the latest Glasgow returns to a similar examination. Table III. summarises the Glasgow fall of solid matter for each of the nine gauges installed in various districts of the city, the returns covering the years 1925–26, 1926–27, and 1927–28, and being expressed as metric tons per 100 square kilometres.

TABLE III.—*Glasgow's Soot and Dust Fall.*

Station.	1925–26.	1926–27.	1927–28.
Alexandra Park	10,294	9,120	9,924
Bellahouston Park	8,609	9,336	10,212
Blytheswood-square	13,257	14,076	15,768
Botannic Gardens	12,428	11,412	13,032
Queen's Park	8,493	9,552	10,116
Richmond Park	11,090	11,100	12,768
Ruchill Park	8,028	9,156	10,512
Toll Cross Park	12,110	13,080	12,576
Victoria Park	11,583	13,932	17,484
Averages for all stations	10,746	11,196	12,488

It will be seen from the figures in the above table that every one of the gauges in Glasgow, with the exception of that in Toll Cross Park, collected an increased amount of solid matter in the year ending March 31st, 1928, and that the general average for Glasgow shows a very considerable increase over the previous year's figure.

Table IV. gives the average annual deposit of solid matter for all the observation stations in Glasgow since the year 1916, expressed, as in the case of the London figures, as tons per square mile; and this table emphasises more clearly than Table III. the retrograde movement which has occurred in connection with air pollution in the northern city.

TABLE IV.—*Glasgow's Soot and Dust Fall from* 1915 to 1928.

Year.	Total solids.	Three years' averages.
1915–16	409	
1916–17	368	405
1917–18	438	
1920–21	325	
1921–22	254	278
1922–23	254	
1923–24	321	
1924–25	285	294
1925–26	275	
1926–27	286	
1927–28	320	

The Glasgow figures for the deposit of solid matter, over a long series of years, show, therefore, the same variations as have been observed in London, for after falling to 254 tons in the years 1921–22–23 the deposit increased to 320 tons for the year ending March 31st, 1928, and the Glasgow total is again now higher

* Mr. Kershaw has made so close a study of air pollution that we publish his article, but we are of the opinion that some of his conclusions—especially with regard to London and Glasgow—are open to question, and we shall be glad to have the views of our readers.—ED., THE E.

than that of the Metropolis. It is the opinion of the writer that the cause of this increase in the Glasgow soot and dust fall is the use since the coal mining struggle of 1926 of cheaper uncleaned or unaccustomed fuels for steam-raising and heating purposes, and that the greater slackness of the firemen and of all engaged in the control of boilers and furnaces has contributed to the increase in the amount of air pollution in the Glasgow city area. Some years ago the Public Health Authorities of Glasgow arranged a series of lectures during the winter months for the education of public opinion concerning the evils of smoke and air pollution; and in order to provide technical information upon correct methods of firing boilers and furnaces, classes for firemen were started at the same time in several quarters of the city. A considerable number of men passed through these classes with beneficial results. In view of the increase of the soot and dust fall in Glasgow since they were discontinued it would seem advisable for the Health Authorities to take the necessary steps for reviving both the public lectures and the classes for those more directly engaged in the combustion of fuel for industrial purposes within the area of the city.

Results from Other Towns and Cities.

Table V. contains the figures for the total deposit of solid matters in twenty-five English and Scotch towns, the results being expressed as tons per square mile per annum, and the last column of the table giving the number of gauges used in each place for calculation of the average soot and dust fall. The towns and cities are arranged in six groups, and Burnley has again the undesirable distinction of heading the table with a deposit of 876 tons per square mile per annum, which is nearly seven times that of Rothamsted, which occupies the lowest place in this list of towns. The remarks made in the introductory paragraph of this article, concerning the undesirability of judging the cleanliness or dirtiness of the atmosphere of a large town by the results obtained with only one gauge, must be kept in mind here, and the Public Health Authorities of Burnley would be wise to instal one or two more gauges in other quarters of the town, if they wish to obtain a better position in this table and also a more correct average for their annual soot and dust fall.

Table V.—*Comparative Figures for the Soot and Dust Fall in Twenty-five English and Scotch Towns and Cities, Expressed as Tons per Square Mile per Annum.*

Place.	1926–27.	1927–28.	No. of gauges.
Group 1.			
Burnley	866	876	1
Group 2.			
St. Helens	572	575	1
Liverpool	560	570	1
Newcastle-on-Tyne	523	558	3
Salford	382	529	3
Group 3.			
Hull	437	463	1
Huddersfield	427	453	2
Rochdale	—	420	10
Group 4.			
Castleford	—	393	1
Leicester	—	388	1
Rotherham	399	380	1
Wakefield	534	378	1
Cardiff	402	356	1
Leeds	—	351	4
Gloucester	357	330	1
Glasgow	286	320	9
Group 5.			
London	—	290	10
Marple	137	267	1
Birmingham	244	235	3
Stoke-on-Trent	206	222	1
Group 6.			
Edinburgh	—	199	2
Kingston-on-Thames	125	162	1
Bournville	164	159	2
Southport	112	143	2
Rothamsted	109	126	1

Note.—When no total is given in the second column of the above table, it denotes that the number of gauges employed for the 1927–28 observations differed from those of the previous year, and that direct comparison of the results for the two years was impracticable.

The second group of towns and cities having total deposits between 500 and 600 tons comprises St. Helens, Liverpool, Newcastle-on-Tyne and Salford, and as a comment upon the above recommendation to Burnley it may be pointed out that Newcastle has improved its position since 1925 in these comparative tables by installing two other gauges on the outskirts of the city, which collect much lower deposits than the one situated in the City-road.

The third group of towns with total deposits between 400 and 500 tons, contains only three names, namely, Hull, Huddersfield, and Rochdale, and it is the fourth group with deposits of 300 to 400 tons which forms the largest class in this table. The majority of these places have only installed one gauge, but London has ten, Glasgow nine, and Leeds four, and Cardiff, Wakefield, Rotherham, and Leicester would be well advised to increase the number of their observation stations if they wish to obtain a more correct figure for their atmospheric pollution.

Glasgow, with a total deposit of 320 tons, occupies the lowest place in this group, and it would be joined by London if the results obtained at the two new stations in Kew Gardens were omitted in calculating the London average, which would then be 316 tons in place of 290 tons. As it is, London is included in Group 5, which contains three other towns, namely, Marple, Stoke-on-Trent, and Birmingham. It is rather puzzling to find such a smoky place as Stoke-on-Trent, in the centre of the Potteries, in such good company in this table of comparative results, and one can only assume that the single soot and dust gauge has been placed in one of the cleanest quarters of the district and not, as is customary in other towns with only one gauge, in the centre of the city.

The comparatively low position of Birmingham in this table is due partly to the inclusion of the results obtained from the gauges arranged in Bournville Works and Village in the average, and if these two results are excluded, Birmingham's soot and dust fall in the year 1927-28 would be 258 tons, which is considerably higher than the figure given in the table.

Group 6 contains the places showing a solid deposit of less than 200 tons per square mile per annum, and it is notsworthy that Edinburgh is contained in this group, and thus substantiates its claim to be, not only the most picturesque, but also the cleanest capital city in the British Isles. Kingston-on-Thames, Bournville, Southport, and Rothamsted are the other members of this Group, and although Rothamsted has the place of honour at the foot of this table, the Woodvale Moss Station at Southport collects an even lower deposit, the relative figures being 120 tons at Woodvale Moss and 126 tons at Rothamsted.

Table VI. contains a list of the places showing the highest and lowest deposits obtained during the year ending March 31st, 1928, in single gauges; and the figures in this table are of considerable interest as showing the great variations in the cleanliness of the atmosphere in different quarters of some of our large cities.

Table VI.—*Highest and Lowest Deposits Collected in Single Gauges for the Year* 1927–28.

Highest.

Place.	Tons.
Newcastle-on-Tyne (City-road)	913
Burnley	876
London (Golden-lane)	595
St. Helens	575
Liverpool	570
Salford (Peel Park)	565
Leeds (Hunslet)	510

Lowest.

Place.	Tons.
Soutport (Woodvale Moss)	120
Rothamsted	126
Birmingham (West Heath)	129
Bournville Village	141
Southport (Hesketh Park)	166
Leeds (Headingly)	168
Bournville Works	177
London (Kew Gardens)	176
Edinburgh (Leith Links)	179
London (Kew Gardens)	199

In closing this article, it may be pointed out that the figures given in Table V. prove that there has been a considerable increase in air pollution in the majority of towns in which the observations are being carried on, during the year ending March 31st, 1928, and that in some places the increase is very considerable. It is now recognised by scientists that the very fine particles of soot and dust which are present in the smoke-cloud of our great cities and centres of industrial activity, can be carried by the air currents into the higher levels of the atmosphere, and in this way spread over very wide areas of the country before they are deposited. This increase of atmospheric pollution, therefore, is a very serious matter for districts far removed from the industrial towns and cities which produce the smoke, especially for those country districts lying on the North, North-East and Eastern sides of industrial areas.

As proof of the great distances to which these finer soot and dust particles may be carried by the wind, the writer may give the results of his own observations in a coast town in North Wales, which is quite fifty miles distant from any large or important centres of industry. In the town where he now lives, an East wind always creates haze and a great loss of sunlight, and there is no doubt whatever that this haze is due to the fine particles of soot and dust which are carried over the district by the East wind, from the distant chimneys of South Lancashire and Northern Cheshire. The atmosphere clears at once when the wind changes to the opposite quarter, and the clearance of the atmosphere is at its best when the wind is from the North-West, and the air is purified from all dust particles by its passage over the Irish Sea. When resident on the North side of Liverpool, in quite a country district, the writer observed the same haziness of atmosphere, when the wind was in a direction to carry the smoke of Liverpool over the quarter in which he lived. No doubt all people who live in country districts can quote from their own experience similar examples of haze and loss of sunlight, when the wind is in the quarter which will carry the finer particles of solid matter from the manufacturing districts or nearest large city, over the district where they reside.

The suppression or diminution of smoke and dust in the atmosphere of towns and cities, and also in centres of manufacturing industry, is therefore a national question, and does not concern only the Health Authorities of the town or city where the smoke is produced. It is certainly necessary, therefore, that our Public Health Authorities, generally, should give more attention to this question, and should back up the efforts of all who are attempting to educate public opinion concerning the economic and other losses due to our unsatisfactory methods of consuming coal, both for domestic and industrial purposes.

The Gear Pump.

By HENRY E. MERRITT, D.Sc.

Because of its simplicity and efficiency, the gear pump forms such an excellent means of handling almost any kind of fluid that its application might with advantage be extended. It is positive in action, gives a continuous discharge, and, having no reciprocating parts, can be operated at a high rate of speed. It can be applied at pressures which are limited only by the design of the casing and bearings, gives a considerable suction lift, and is no more difficult to lubricate than any other rotary pump. Its only limitation is that it will not deal efficiently with fluids having solid abrasive matter in suspension.

The gear pump has only two working parts, both of which are simple toothed gears. The teeth, however, perform two separate and distinct functions; first, they form the means by which the fluid is transferred from inlet to discharge; secondly, they act as gear teeth in order to provide the drive between the rotors. (This latter function can, of course, be performed by external gearing, as in the case of the Roots blower, but this type of pump is not here considered.) The profiles and proportions of the teeth must therefore be designed to fulfil not only the conditions of uniform velocity transmission, but must also minimise or eliminate the several forms of hydraulic loss which can occur. Furthermore, they must, for reasons of economy in design, give the maximum discharge for a given size of pump.

The Action of the Gear Pump.—In order to appreciate the many points which must be considered in design it is necessary to study in detail all the phases in the action of the intermeshing rotors.

Fig. 1 shows a typical gear pump, the description

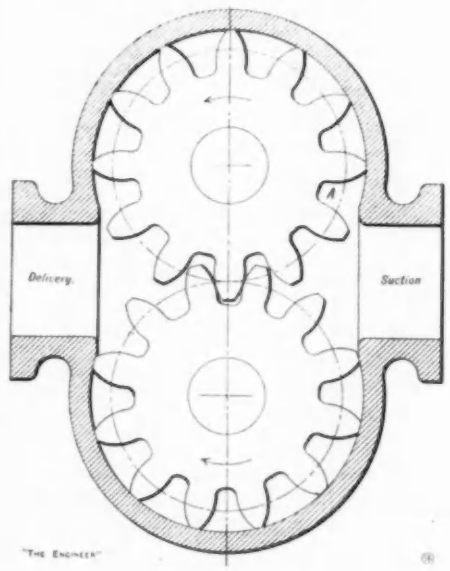


Fig. 1

"typical" meaning that the design is only indifferently good. This example is chosen as showing, not only the action of, but also the possible objections to, the designs commonly encountered. The rotors, we will say, have twelve teeth of the standard proportions and 20 deg. pressure angle. Sometimes 14½ deg. pressure angle is used, but this makes the tooth form quite unnecessarily bad. We will also assume, as is commonly the case, that the gears are specified to have no backlash.

Starting with the pump full of fluid, rotation of the rotors carries fluid from the suction to the delivery chamber in the pockets between the teeth. The fluid, or most of it, is expelled from each pocket and made to pass to the delivery chamber by the tooth on the mating rotor which intermeshes between the teeth forming the pocket—as the gears pass into engagement. After the teeth have passed the pitch point they separate and the pockets regain their full volume, but while this occurs they are, of course, in communication with the suction chamber. The teeth, therefore, fill again with fluid and the cycle is repeated. That is the broad outline; now for a little more detail.

Consider the tooth space A, Fig. 1. In the position shown it is in communication with the suction chamber, and we will assume it to be full of fluid. In Fig. 2 (*a*) it has travelled round and its full volume—shown cross hatched—has been maintained, but in the position shown tooth B is about to start to reduce the volume of space A. As the rotors continue to move tooth B displaces fluid from space A and in the position shown in Fig. 2 (*b*) tooth B has made contact with the tip of tooth A_1 at the point C.

After this point teeth A and B are in contact and the volume of space A is decreasing, all the fluid expelled by tooth B passing through the space between the tip of tooth B and the flank of tooth A_2 with some velocity. There comes a moment when the tip of tooth B and the flank of tooth A_2 make contact; this condition is shown in Fig. 2 (*c*). Of the original volume

of space A only that shown shaded remains. This volume is divided into the two portions a_1 and a_2.

Now with further rotation of the rotors spaces a_1 and a_2 are further reduced and the fluid in space a_2 is expelled to the delivery chamber; but the fluid left in space a_1 is trapped. A very high pressure therefore tends to develop in space a_1 and this pressure will depend upon the velocity with which the fluid escapes, *i.e.*, upon the area of the passages through which this escape is possible. These passages can exist either as end clearance between the rotors and the casing or as the inevitable backlash, even when it is—unwisely—attempted to reduce it to a minimum. If the rotors are running at an appreciable speed and these clearances are small, there will be considerable loss of power and a noticeable knock as every tooth comes into this position. The pressure may even be high enough

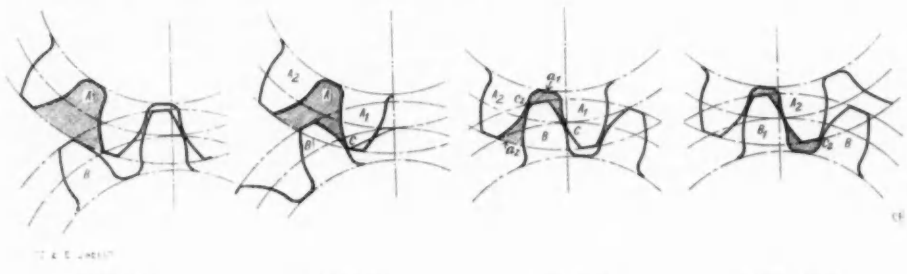


FIG. 2 (*a*) FIG. 2 (*b*) FIG. 2 (*c*) FIG. 2 (*d*)

to spring the shafts of the rotors and cause the latter to strike with the tips of the teeth against the casing; sometimes the marks of contact between teeth and casing can clearly be seen.

As the rotors rotate further the space a_1 diminishes and some of the fluid may possibly be displaced towards the discharge side, but more probably it will leak back to suction. The fluid in space a_2 will, however, be displaced into the space between tooth B and tooth B_1, this being completed by the time the stage shown in Fig. 2 *d* is reached. At this point there will be similar trapping in the space between B and B_1, but it is convenient to regard the fluid here trapped as having been originally in the space between B and B_1, and that the whole of the fluid in a_2 has been displaced to the discharge side.

The total discharge of the pump per tooth is therefore the volume of the space A—Fig. 2*a*—minus the volume of the trapped fluid in space a_1—Fig. 2*c*. This net volume for one complete revolution is approximately equal to the area between the pitch circle and the addendum circle multiplied by the face width, for each rotor—actually it is a little less than this—and consequently the greater the addendum for a given pitch diameter and face width the greater the discharge. Consequently if the ratio of addendum to circular pitch is kept the same the discharge will increase as the number of teeth is reduced. As a first approximation, for example, two twelve-tooth rotors, 1 D.P., 1in. face, would discharge

$$2 \cdot \frac{\pi}{4} (14^2 - 12^2) = 26\,\pi \text{ cubic inches}$$

per revolution, whereas if made with eight teeth of full standard depth—the teeth being now $\frac{2}{3}$ D.P. on the same pitch diameter—the discharge will be

$$2 \cdot \frac{\pi}{4} (15^2 - 12^2) = 40{\cdot}5\,\pi \text{ cubic inches.}$$

The increase is thus rather more than 50 per cent.

In the case of the twelve-tooth involute rotor above considered there is another question to be dealt with, and that is the action of the teeth regarded as gears and not as a means of transferring fluid. In actual practice the flanks of the teeth would certainly be undercut during the generating process and full involute contact is not then obtained, although in this instance there is sufficient to provide the overlap

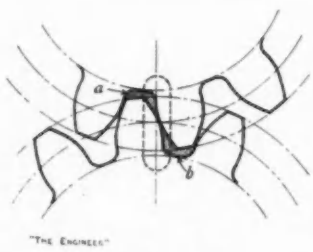


FIG. 3

of contact necessary for uniform velocity transmission. The tooth action will be dealt with later under the heading "Minimum number of teeth."

Methods for Avoiding Trapping.—Various methods are adopted for relieving trapping between the teeth, some forming good examples of misdirected ingenuity.

One of the most common is shown in Fig. 3; it consists in forming a recess in the end covers as shown by the dotted line, so connecting the trapped volume *a* with the trapped volume *b*. In this way fluid displaced from the diminishing space *a* can pass to the correspondingly increasing space *b*. If the face width is wide, however, and the rotational speed high enough to make some provision for avoiding trapping desirable, the area of the transfer passage will not be large enough to enable the fluid to pass from one passage to the other without very high pressures being induced. The width of the slot must also be narrower than the shortest distance apart of any two points of contact, otherwise there will at one instant be a direct passage between delivery and suction.

A peculiar method of German origin is shown in Fig. 4. Here the rotors are bored and run on fixed spindles; holes are drilled through the roots of the teeth and communicate with recesses cut in the spindles. These recesses are so placed that the holes are only uncovered whilst trapping is taking place. This design, which must necessarily involve a large root diameter of the rotor, and hence an unnecessarily large number of teeth, besides the other complications, makes the pump unduly large and costly. Completely to avoid trapping, all that is necessary is to provide a moderate degree of backlash together with duration of contact which gives a minimum of overlap.

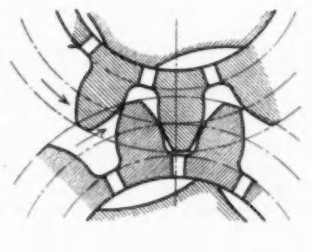


FIG. 4

This can clearly be seen from Fig. 5. Suppose that the rotor with teeth A_1 and A_2 is the driver, and that contact takes place at C_1 and C_2, C_1 being the first point of contact of tooth A_1 and tooth B_1. Then as the space a_1 is diminished the fluid has a direct path through the space formed by the backlash to the increasing volume of space a_2. If, of course, the distance of C_1 from the pitch point P is greater than the distance of C_2 from P, space a_1 diminishes faster than space a_2 increases; but if there is a minimum of overlap of contact the difference in the rate of change of volume of spaces a_1 and a_2 is so small and the period during which two teeth are in contact is so short that trapping, though theoretically present in a small degree, is in actual practice quite imperceptible. As soon as the teeth have moved until C_1 is the only point of contact the fluid in space a_1 has a clear path back to the suction side.

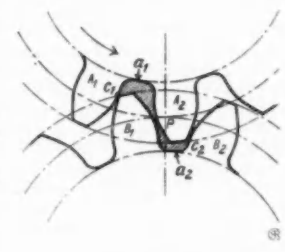


FIG. 5

The conditions to be observed in gear pump design can therefore be briefly stated as follows:—

(1) For maximum discharge: minimum number of full-depth teeth.

(2) For minimum trapping: adequate backlash and minimum overlap of contact.

(3) For tooth durability: freedom from undercutting and maximum tooth surface.

DESIGN OF INVOLUTE ROTORS.

Undercutting.—The factor which imposes the chief limitation upon involute rotor design is the occurrence of undercutting. This is the result of the generating process; the effect is to destroy part of the involute flank of the tooth. In consequence part of the face of the teeth of the mating teeth may not make contact at all; in extreme cases so much involute may be destroyed that continuous uniform motion is not transmitted. Space does not permit too wide a digression into the subject of undercutting in general, but a brief outline of the manner of its occurrence may be given.

The method of generation will be assumed to be by rack cutter. The results of this process are very similar to those produced by hobbing, and although the undercutting is more severe than if the Fellows gear shaper is used, it is necessary to legislate for the worst case.

Fig. 6 shows the rack cutter in process of generating a pinion tooth. In position I it has already generated the greater portion of the involute, the involute portion of the profile and the rack tooth making contact along the line *a* P. As the cutter moves towards the left in the diagram it reaches the position marked II, when the cutter flank is radial to the blank. In this position the involute is completed and the end of the involute is at the point I, termed the interference point. With further movement of the cutter the tip sweeps out a curve which forms the fillet in the root of the tooth and this curve cuts away the involute above the base circle. Position III shows the cutter in the position when interference is complete. It will be clear that if the tooth were again meshed with the rack tooth involute contact would start at *a* as before, but would terminate at some point *e*.

If, therefore, the pinion be meshed with another similar pinion, as illustrated in Fig. 7, contact would cease in the position shown, where contact occurs at the point *e* corresponding to that in Fig. 6. Hence the portion of the involute face of the mating pinion above *e* is quite useless, and, in fact, detrimental as soon as wear begins. Furthermore, the total length of the path of contact is only twice the length P *e*, and if this is less than the normal distance between adjacent involutes contact is incomplete.

Effect of Pressure Angle.—The amount of undercutting depends upon how far the straight part of the rack extends beyond the interference point I, and consequently the greater the pressure angle the smaller the distance 0 I and the greater the allowable rack cutter addendum before undercutting begins.

If the addendum is equal to the module, the number of teeth below which undercutting is present is given by

$$t = \frac{2}{\sin^2 \psi}$$

where ψ is the pressure angle.

Consequently for 14½ deg. pressure angle $t = 32$

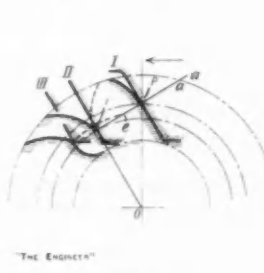


FIG. 6

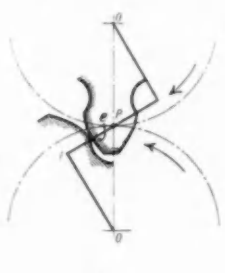


FIG. 7

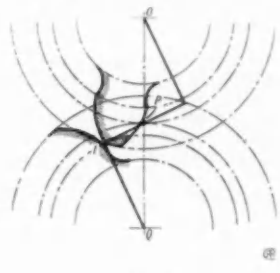


FIG. 8

and for 20 deg. pressure angle $t = 17$. Since the possible path of contact is less than that of the rack, however, these numbers of teeth are not the ultimate limit; actually the limits are twenty-six and fourteen for 14½ deg. and 20 deg. pressure angles respectively. If fewer teeth than these are used the condition shown in Fig. 7 occurs and the contact is not good. The minimum number of teeth with 20 deg. pressure angle and undercut teeth is eleven. This gives bad contact, but does just give overlap from one tooth to the next; below this the motion is not uniform.

Special Methods of Tooth Design.—A method of reducing undercutting is to apply a considerable radius to the corner of the generating cutter. It is then possible to carry the contact between the two pinions down to the interference point. The conditions are then as shown in Fig. 8. The maximum overall diameter of the pinions is, in this case, twice the dimension 0 I. From the geometry of the diagram

$$0\,I^2 = O\,P^2 + P\,I^2 + 2\,O\,P \cdot P\,I \cdot \sin\psi$$
$$= \frac{d^2}{4} + \frac{d^2}{4} \sin^2\psi + 2\,\frac{d^2}{4} \cdot \sin^2\psi$$
$$= \frac{d^2}{4}(1 + 3\sin^2\psi)$$

$$\text{Hence } 0\,I = \frac{d}{2}\sqrt{1 + 3\sin^2\psi}$$

$$\text{and } a = \frac{d}{2}\left[\sqrt{1 + 3\sin^2\psi} - 1\right]$$

For 20 deg. pressure angle, inserting values—

$$a = d \times {\cdot}081,$$

and hence if a = module (*i.e.*, standard proportions),

$$d = 12{\cdot}3\,a = 12{\cdot}3\,M.$$

Hence 12 teeth is the minimum.

For higher pressure angles, this minimum number of teeth becomes still less, but another complication then sets in. This follows the tendency of the involutes to run to a point, necessitating a shallower tooth.

Higher pressure angles can be cut with standard cutters by increasing the centre distance of the gears above the standard for the given numbers of teeth, but this also involves very complicated calculations

regarding tooth depth and backlash, which cannot be dealt with here.

The Roloid Pump Rotor Tooth.

The name Roloid has been given to a special tooth form evolved by the writer, and applied commercially for pump rotors with considerable success.

The feature of this tooth form is that it has a path of contact of double curvature, so designed as completely to eliminate undercutting, whilst the teeth do not tend to run to a point as is the case with involute teeth. Consequently, pump rotors can be designed with as few teeth as are required, retaining the full standard proportions for depth. Actually, equal pinions having as few as six teeth can be generated without undercutting, but eight teeth have been adopted as standard in order to allow a bore of sufficient diameter to give the requisite strength of shaft.

Table for Dimensions and Discharge of Eight-toothed Roloid Pumps, for 1in. Face.

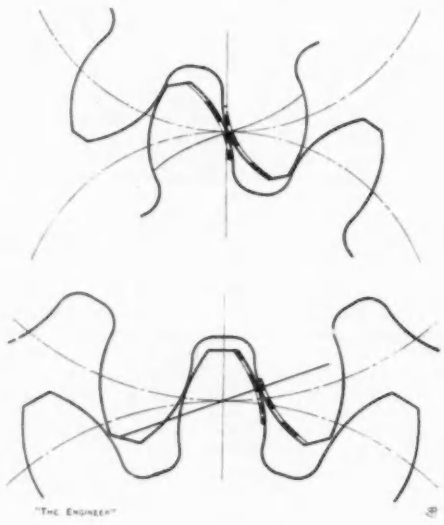
Pitch (D.P.)	8	6	5	4	3	2½	2	1½	1¼
Pitch diameter	1·000	1·333	1·60	2·00	2·667	3·20	4·00	5·333	6·40
Overall	1·25	1·667	2·00	2·50	3·33	4·00	5·00	6·667	8·00
Root diameter	·07	·933	1·12	1·40	1·867	2·24	2·80	3·733	1·48
Gallons per 100 revs. (90 per cent. volumetric efficiency)	·27	·48	·69	1·08	1·92	2·76	4·3	7·65	11·1

Fig. 9 shows the tooth form of standard eight-tooth Roloid rotors and the curved path of contact. This illustration will serve to show, first, the reason for the absence of undercutting, and, secondly, the no less favourable conditions of tooth engagement and wear distribution, as compared with a pair of twelve-tooth involute rotors with undercutting removed by a specially rounded generating cutter.

Technically, undercutting commences when the path of contact ceases to approach the centre of the gear being generated. With involute teeth, this takes place at the interference point, where the path of contact is tangential to the "base circle" of the tooth involutes. In the case of the Roloid tooth there is no such point of tangency, and consequently no undercutting.

Tooth wear is also a matter of considerable importance, particularly in view of the fact that many fluids dealt with by gear pumps have little or no lubricating value.

Tooth wear is the result of the sliding action between the teeth, and its extent is proportional to the amount of sliding which takes place over any given length of active tooth profile. In order to be able to compare conditions of tooth engagement, it is convenient to use the well-known method of marking off in alternate black and white bands the portions of the profiles which engage with each other. This has been done



FIGS. 9 AND 10

in the case of Figs. 9 and 10 for every one-fifth of a pitch of movement of the gears. For every such amount of movement, the point of contact moves over one black or one white band, as the case may be; hence the length of the band represents the area of the tooth surface over which the wear occurring during this interval is distributed. The actual amount of sliding is equal to the difference in the lengths of co-acting bands. Hence the longer the band, and the less the difference in length, the less the rate of wear.

When it is considered that the eight-tooth Roloid rotors give 50 per cent. more discharge than the twelve-tooth involute rotors, it is seen that the Roloid has a considerable advantage over the involute.

Proportions and Discharge of Roloid Rotors.

If gear pumps have already been designed with involute teeth of standard proportions, Roloid teeth could be substituted, but unless the involute teeth are already severely undercut, this does not take full advantage of the possibilities of the Roloid tooth. Supposing, for instance, that ordinary involute teeth are used, taking twelve teeth at 6 D.P., substitution of Roloid teeth would only improve the durability of the gears without affecting the discharge. If, however, the body of the pump is modified to take eight Roloid teeth of 4 D.P., the delivery is at once increased by 50 per cent., or by using eight Roloid teeth of 5 D.P. and the same face width, the discharge is maintained with a smaller, lighter and cheaper pump.

Roloid teeth have, as already mentioned, the same addendum as standard involute teeth for a given pitch, but the bottom clearance has been slightly increased to provide a more effective fillet at the roots. The formulæ for detail design are—

$$\text{Addendum} = 1 \div \text{diametral pitch.}$$
$$\text{Dedendum} = 1{\cdot}2 \div \text{diametral pitch.}$$
$$\text{Clearance} = 0{\cdot}2 \div \text{diametral pitch.}$$

For standard eight-toothed rotors—

$$\text{Pitch diameter} = 8 \div \text{diametral pitch}$$
$$\text{Overall} = 10 \div \text{diametral pitch}$$
$$\text{Root} = 5{\cdot}6 \div \text{diametral pitch}$$

The discharge is calculated from the formula—

$$\text{Discharge, cub. in.} = E.K.C^2.f \text{ per revolution,}$$

where E = volumetric efficiency;
K = a factor for the number of teeth;
C = centre distance, inches;
f = face width, inches.

The volumetric efficiency for moderate speeds may be between 90 and 95 per cent., though at high speeds it may fall to 80 per cent.

The coefficient K is ·84 for eight-toothed rotors and for other numbers of teeth is given in the following table:—

Table for Discharge Coefficient K.

f	8	9	10	11	12
K	·84	·73	·65	·59	·53

The Isle Maligne Power Station on the Saguenay River.

One of the largest single installations in water power development ever undertaken is that at Isle Maligne on the Saguenay River, in the province of Quebec, where a total installation of 540,000 H.P., with twelve 45,000 H.P. turbine emplacements, has been made by the Quebec Development Company, Ltd.

The Saguenay River, which is one of the great tributaries of the St. Lawrence River, flows out of Lake St. John by two channels, known as the Grand Discharge and the Little Discharge respectively. These two channels unite at a point 9 miles below the lake outlet, and 13 miles further downstream the Saguenay River reaches tide water. Lake St. John is situated about 100 miles north of the city of Quebec. Its normal water level is about 310ft. above mean sea level, and the area draining to it is estimated to be 30,000 square miles. Isle Maligne, the last of the many islands in the Grand Discharge is about 1¼ miles long, and the river flows past it in two rocky gorges. Its foot is about 2 miles above the junction of the Grand Discharge with the Little Discharge, and at the first-named point the mean low-water level of the river is 105ft. below the ordinary low-water level of Lake St. John, and 122·5ft. below the top water level of the fully impounded lake.

After exhaustive investigation it was decided to construct the power house in the left channel of the Grand Discharge at the downstream end of Isle Maligne by a spillway. At this site the river is deeply cut in rock, and it was necessary to provide additional spillways on Isle Maligne, which is sparsely covered with soil above its granitic formation. In addition, an earth barrage was required, in the ravine near the spillway, on Alma Island, between the Grand Discharge and the Little Discharge, so as to extend Lake St. John to the intake structure of the power house.

Authority to begin the construction of this important power undertaking was given in December, 1922. At that time, Isle Maligne, where the principal amount of the construction was to be done, was practically inaccessible. The nearest railway station was Herbertville, on the Canadian National Railway line, about 11 miles south of the power site, and the nearest settlement was St. Joseph d'Alma on the Little Discharge, which was connected with Herbertville by a fairly good highway, but with heavy gradients, extending to and crossing the Grand Discharge on a covered wooden bridge, 1 mile below Isle Maligne. Severe winters of long duration had to be faced. Except for getting in the workpeople and doing some sledge haulage of materials and supplies for the preliminary work of the first winter, the highway was not considered of much use, whereas a railway would provide a short haul, with reasonable gradients, unbroken shipments, load capacity, volume of traffic, and means of handling the snow, none of which were available by any other practicable road. The construction of an 11-mile railway line was, therefore, decided on and immediately begun. The line crosses the Bedard River—a low and high water channel of the Little Discharge—above St. Joseph D'Alma and the right channel of the Grand Discharge at the foot of Isle Maligne. The track is ballasted and laid with 70 lb. rail, and all bridges are of steel on concrete piers, the longest being that to Isle Maligne. This latter bridge consists of two 90ft. long and one 220ft. long truss spans for double-track service. The railway was completed to the terminus at Grand Discharge opposite Isle Maligne in the middle of August, 1923, and transportation across the bridge to Isle Maligne was started at the end of October of the same year. The next important step was to provide means of housing and feeding 1600 workmen, and to furnish homes for the company's employees and their families. The plateau above the railway terminus on Alma Island opposite Isle Maligne, and overlooking the construction operations in the south, was considered to be the most favourable position for a construction camp, inasmuch as it was close to the works and allowed of natural drainage. The town that was built is called Isle Maligne, and has been made an official postal station. Particular attention was given to the water supply. Water from the river is pumped to a 20,000-gallon tank on a hill above the camp, and thence distributed over the camp and works. The distribution was rather expensive because of the cold climate. All pipes had to be placed at least 6ft. under ground to prevent freezing, and much of the trenching was in rock. Chlorination is employed, for while the large volume of river flow made the danger from pollution rather remote, it was felt necessary to guard against typhoid as fully as possible.

Construction Plant.

Having the situation and type of permanent structures fixed, and the volume of work to be done determined, progress schedules giving the time allowed for the completion of each structure, were prepared, keeping always in mind the fact that climate and stream flow set the time when certain construction operations could be begun and must be finished. The main construction items in this development are concrete masonry and excavation, largely in rock, and the steel work for the turbines and power house. The estimated masonry quantities in the Grand Discharge are as follows:—

	Cubic yards.
Power-house bulkhead and sub-structure	288,000
Power-house bulkhead extension	40,500
Splash wall and retaining walls	10,000
Spillway No. 1	51,500
Spillway No. 2	3,000
Spillway No. 3	29,000
Spillway No. 4	80,000
Total	502,000

The estimated quantity of masonry in the Little Discharge is 20,000 cubic yards. Connecting with the railway terminus on Alma Island, a track system was laid out to all structures and construction plant units, practically eliminating job haulage by any other means. Since the bulk of the masonry was to be placed near the foot of Isle Maligne, the crusher and mixer plant was placed on the Alma shore, near the double-track bridge across the right channel of the Grand Discharge. There, the topographical conditions were favourable for the lay-out of a gravity crushing plant. A large sand pit and quarry, supplementing the stone supply from the tail race excavation, were also close by along the railway to Herbertville, and cement could be quickly brought in. In the Little Discharge, for the construction of the isolated spillways containing a comparatively small quantity of masonry, an individual mixer plant was provided. The whole design and lay-out of the construction plant were given as much attention as the design of the power-house. It has since been maintained by the engineers that had that not been done at the Isle Maligne Station, the great amount of work could never have been executed in the same length of time.

For the earlier operations in connection with the cofferdam construction at the head of Isle Maligne and the service track construction, an 8in. by 8in. petrol-engine-driven portable compressor of 210 cubic foot per minute displacement and a stationary steam-driven compressor of 340 cubic feet per minute displacement, supplied from one 100 H.P. boiler, were used. The main air compressor plant is arranged on Alma Island, 300ft. south of the bridge to Isle Maligne. It consists of two 350 H.P., 2200-volt, 200 revolutions per minute, three-phase, 60-cycle, synchronous motors, direct connected to cross-compound compressors of the clearance-control type. Each compressor has cylinders of 25in. and 15¾in. diameter, with 18in. stroke, and a capacity of 2033 cubic feet of free air per minute. A separate compressor plant, of 350 cubic feet per minute free air capacity, was provided for riveting.

A machine shop, near the compressor plant, was

THE BRITISH INDUSTRIES FAIR

SOME OF THE EXHIBITS AT BIRMINGHAM

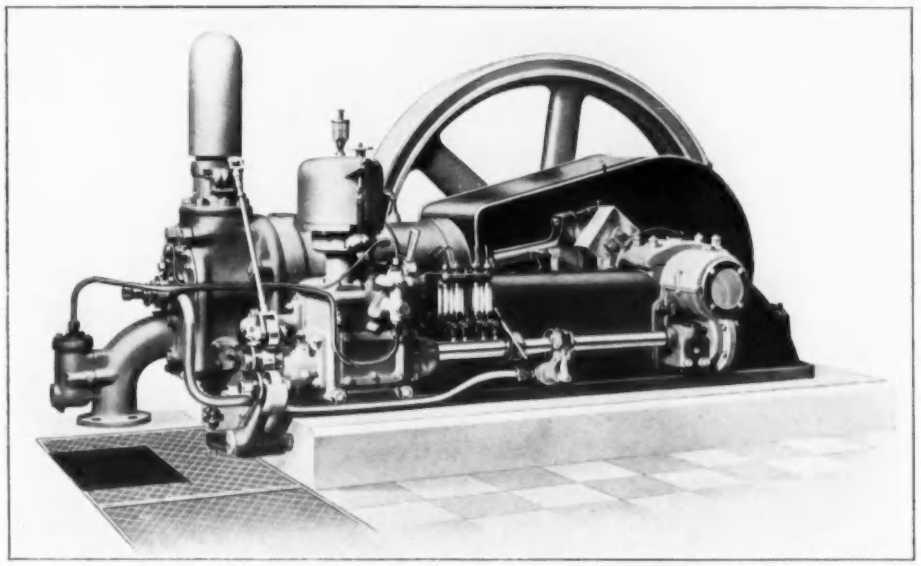


FIG. I. 30 H.P. OIL ENGINE MARSHALL

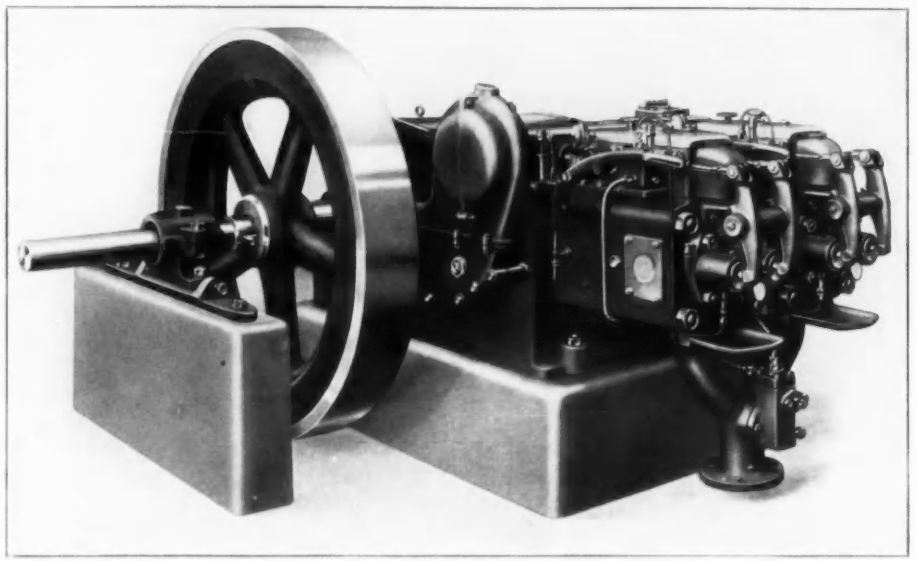


FIG II. TWIN-CYLINDER HEAVY OIL ENGINE—CROSSLEY

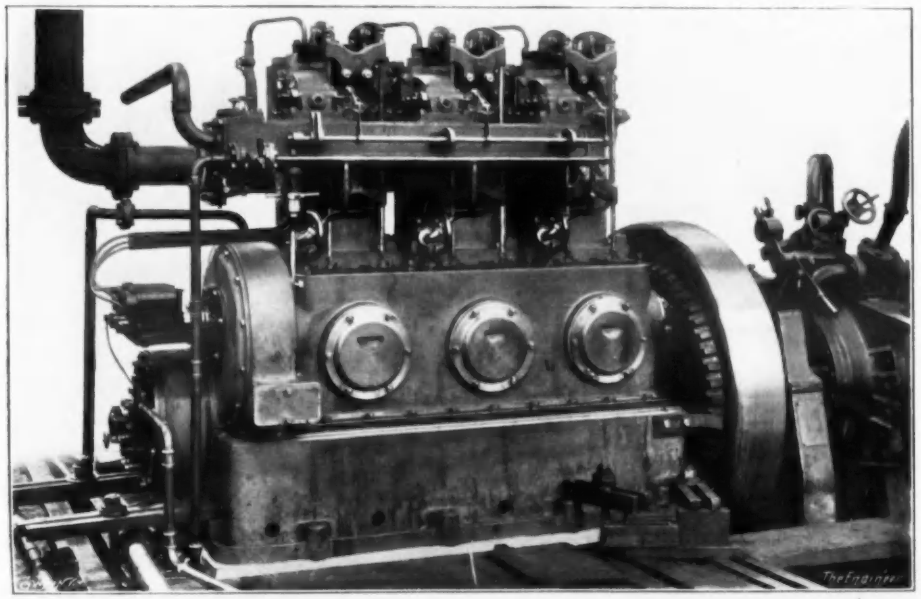


FIG. III. 75 H.P. GAS ENGINE NATIONAL

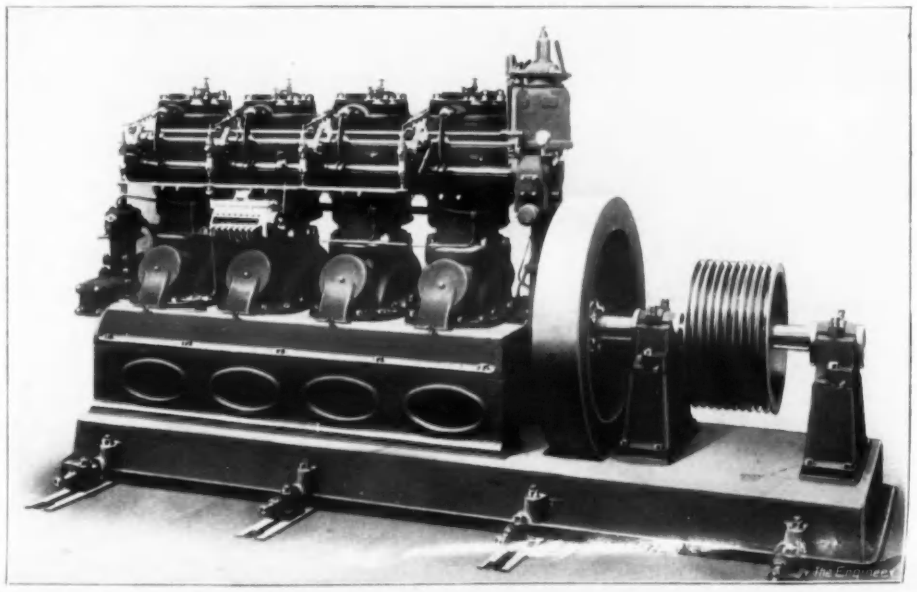
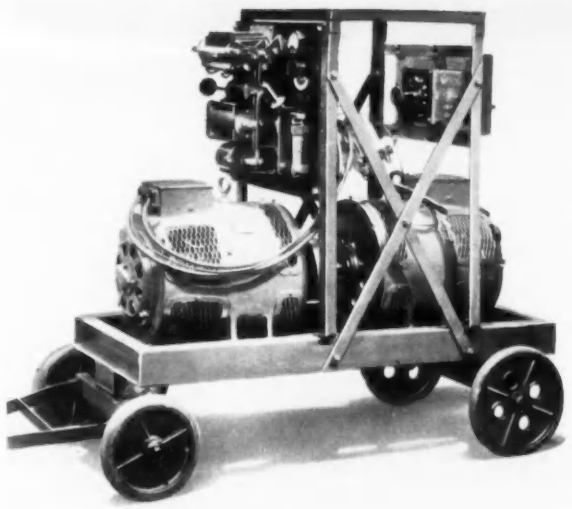
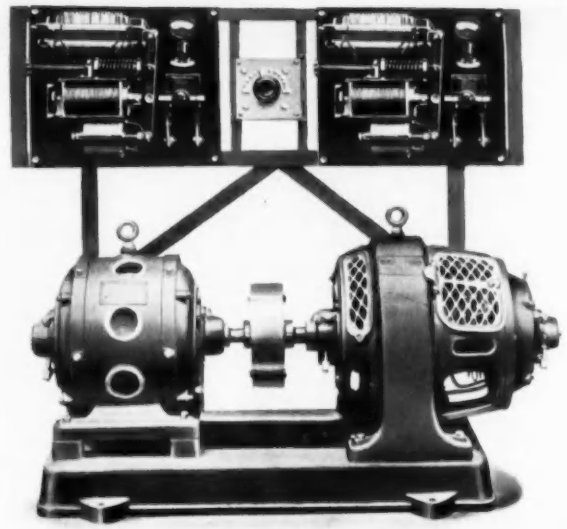


FIG. IV. 152 H.P. OIL ENGINE NORRIS, HENTY

FIG. III. 75 H.P. GAS ENGINE NATIONAL

FIG. IV. 152 H.P. OIL ENGINE NORRIS, HENTY





FIGS. V. AND VI. ARC WELDING SETS PETERS

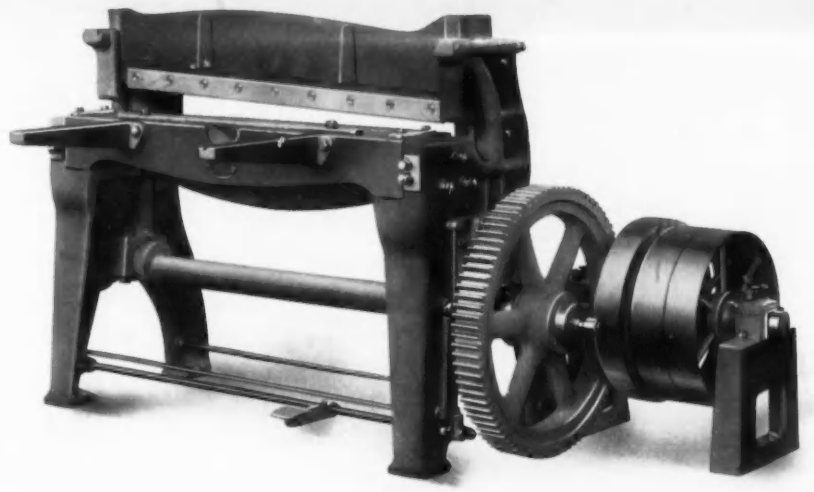


FIG. VII. GUILLOTINE SHEARS BROOKES

FIG. VIII. STEEL WATER HEATER PAXMAN

FIG. IX. SPRAYING SET MIDLAND FAN

FIG. X. BRICK BREAKER WINGET

fitted with planers, drills, a lathe, shears, bolt and pipe machines and forges. It was used for maintenance of rolling stock, general repair work and the manufacture of smaller articles, and it was large enough for the construction of flat cars, points and crossings, of which a number were built.

Electric Power Supply.

With the exception of steam shovels, locomotive cranes, and railway locomotives, all construction and shop equipment was motor operated, and the aggregate motor equipment was 5000 H.P. Price Brothers and Co., Ltd., who are connected with the development of power on the Saguenay, have a hydro-electric plant at Chicoutimi, from which they furnished the electric power. Early in 1923, a 40-mile, 44,000-volt, three-phase transmission line was run from the Chicoutimi plant to Isle Maligne, and at the works the current was stepped down to 2300 volts for the larger motors and to 440 volts and 220 volts respectively for the smaller motors and lighting circuits distributed about the camp and works. Altogether, about fifty odd motors were required, and all but two or three were of the A.C. induction type. The largest motors were of 400 H.P., for the jaw crusher and sluicing pump, 350 H.P. for the air compressors, and 200 H.P. for the No. 15 crusher. The derrick motors were all of 100 H.P.

For the delivery of the concrete from the mixer plant, full-batch buckets, consisting of 4 cubic yard bottom-dumping buckets, were used, while 2 cubic yard buckets were employed for structures of smaller volume. The concrete was handled on flat cars of 80,000 lb. to 100,000 lb. capacity, which took four 4 cubic yard or six 2 cubic yard buckets. Certain work, such as portions of the power-house substructure, were built by depositing the concrete by means of chutes. For this purpose, special 4 cubic yard wooden boxes provided with steel gates were built, and four of them could be placed on a flat car. By suitable operation of the concrete train, a box was brought opposite a chute and the gate then opened for discharging the concrete directly through the chute to its final place.

Hoisting Equipment.

With the exception of two small wooden stiff-leg derricks, all the derricks used were built of steel, and their capacities were in proportion to the power required for handling the 4 cubic yard bottom-dump concrete buckets. Nine steel stiff-leg derricks and six steel guy derricks were distributed over the various parts of the work. Of special interest were the five traveller cranes built for the construction of the power-house bulkhead and substructure, and for subsequent use in connection with the construction of spillway No. 4. Each crane consisted of two stiff-leg derricks with individual hoisting engines mounted on top of a portal of steel construction. This portal had a length of 36ft., a span of 43·5ft. between centres of runways, and a clearance of 19ft. above the three railway tracks, arranged within the traveller span permitting trains and locomotive cranes to pass under it. These two derricks handled a load of 10 tons per boom at a radius of 80ft. and 20 tons per boom at a radius of 40ft.

The twenty-five hoisting engines for the various derricks were of the double-drum type for $\frac{3}{4}$in. and $\frac{5}{8}$in. diameter rope, and had interchangeable parts. Each hoist was fitted with a 100 H.P. motor running at 900 revolutions per minute, and was equipped with a drum controller and resistance for three-phase, 60-cycle, 440-volt current. Based on 75 per cent. of the motor horse-power, the rating of the hoist was 9000 lb. at a speed of 275ft. per minute on a single line.

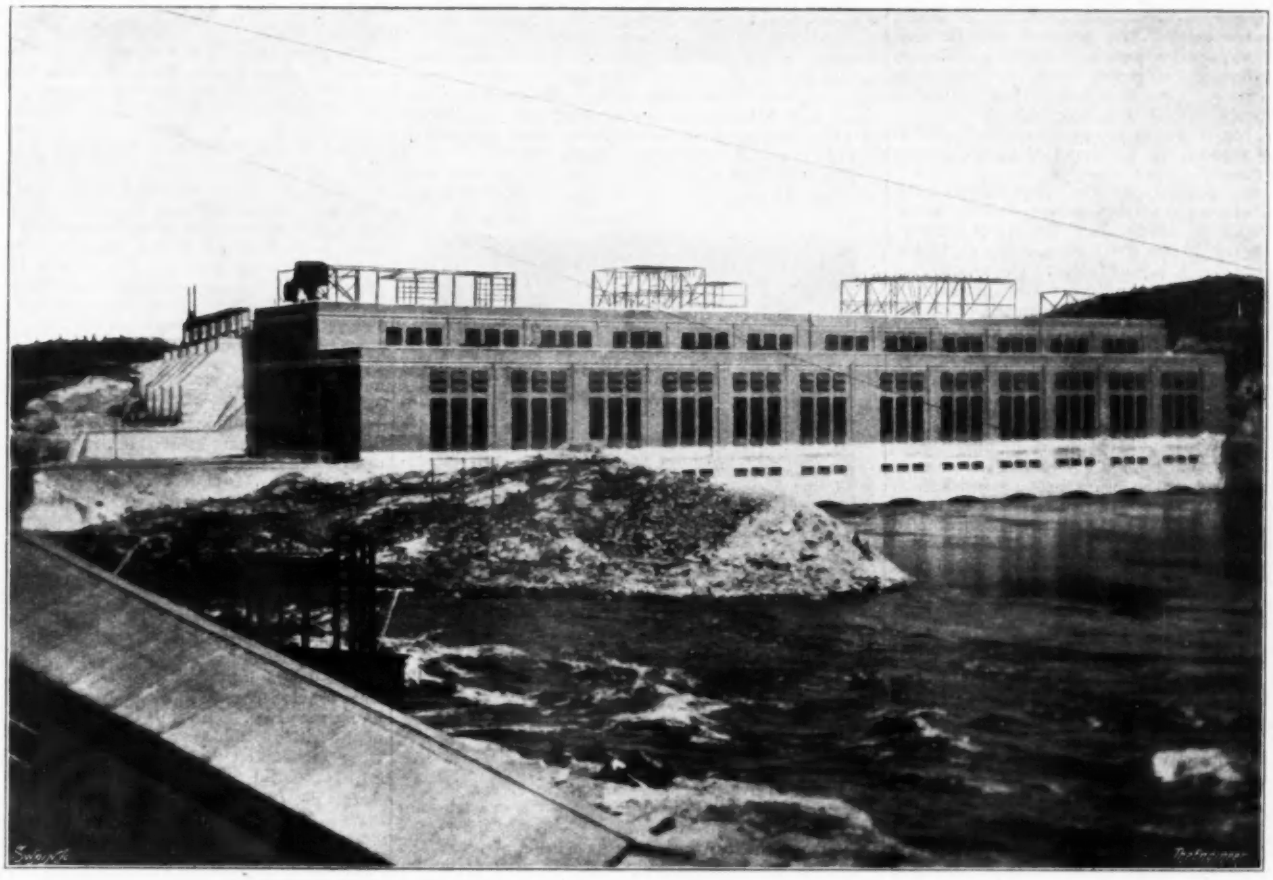
General Description of Works.

In view of the 720ft. overall length of the power-house and the 163·5ft. width of the power-house bulkhead and substructure at the base, it was deemed necessary to provide for expansion and contraction of the structure with temperature changes. An expansion joint was, therefore, provided along the entire building. It separates the massive bulkhead structure from the cut-up substructure containing the turbines. The plate steel intake pipes embedded in the bulkhead masonry are connected to the respective turbine spiral casings by plate steel stuffing-boxes, which allow for minor movements caused by temperature changes. Transverse expansion joints, splitting up the power-house substructure into blocks of 108ft. length and conforming to the required spacing of two turbine units, were also provided.

The rack structure at the upstream face of the power-house bulkhead is built of reinforced concrete and structural steel. The top of the rack bars is at elevation 236·0, or 4ft. below the ordinary low-water level of Lake St. John. The spacing of the 6in. by $\frac{3}{4}$in. rack bars is $4\frac{1}{2}$in. centre to centre. The intake to each of the twelve turbine flumes consists of two 10ft. by 22ft. openings formed in the concrete masonry. Each opening contains a rectangular gate of the butterfly valve type, having in the centre a cast steel girder 2ft. 8in. deep and 2ft. 6in. wide, with bronze-bushed trunnions 18in. outside diameter and 24in. long at each end. The wings of the cast iron are firmly attached to the girder by machined bolts and shrink rods. A built-up cast iron wall frame securely anchored to the masonry is provided with machine-finished surfaces at its lower half, at which point the surfaces of the gate and wall frame come in direct contact. The upper half of the wall frame has machine-finished bevelled faces conforming to similar surfaces on the gate. The slot between the upper half of the gate and the wall frame is sealed by a set of brass flaps attached to the upstream end of the wall frame. Each gate is operated by a separate, completely-enclosed hoist, arranged on top of the power-house bulkhead.

The design of the gate is such that the connecting-rod, consisting of a 9in. extra heavy steel pipe, is in tension under all operating conditions. To prevent buckling of the connecting-rod when the gate is reaching its lowest position, the upper pin connection of the rod is machine-slotted for the pin in the cross-head to allow a 4in. overtravel on the downward stroke. There is also a nest of heavy coil springs in the gear housing of the hoist, which acts as a cushion for the operating stand in the range of overtravel on the downward stroke, and gradually creates the necessary overload, causing a tripping of the over-load release switch. An allowance of 24in. for over-travel on the upward stroke is made by proportioning the length of the screw stem and crosshead guide. A gate-position indicator, as well as a limit switch arrangement of moisture and spray-proof construction, are provided on top of the hoist.

Two hundred and thirty-volt, direct-current power is supplied for the operation of the hoists. Each head-gate motor is completely enclosed, and has a starting torque of 275 foot-pounds, and a running torque of 140 foot-pounds, based on six minutes' service with a temperature rise not exceeding 55 deg. Cent. Under the most severe operating conditions, the gate may be completely closed or opened in five minutes. A weatherproof push-button control station is provided on the top of the bulkhead for each hoisting mechanism, and there is a non-weatherproof control station on the power-house bench board for distant closing of each gate. The emergency push-button control on the switchboard is for use in the case of accident only, as the intake gates can be readily closed when the generator is operating under full load.



DOWNSTREAM VIEW OF POWER-HOUSE

Each of the twelve turbine flumes formed in the concrete masonry of the power-house bulkhead gradually converged into a 22ft. diameter opening which is the beginning of a plate steel intake pipe forming an extension of the turbine spiral casing embedded in the power-house sub-structure.

The power-house superstructure is built of hollow tile and face brick of buff colour which encase a structural steel frame supporting the roof trusses and the steel runways for the two 100-ton capacity electric cranes in the generator room. The hollow tile face in the interior of the power-house is covered with plaster and is finished with a coat of paint. The generator floor and the 5ft. high inside face of the concrete water table are covered with glazed tile. The large window sashes are built of steel and are securely attached to the steel columns supporting the roof trusses. The roof consists of reinforced gypsum slabs resting on steel purlins and the top of the slabs has a finish of tar and gravel.

Tail-race.

When all twelve turbines are operating at full load and under 110ft. effective head the total discharge into the tail-race is estimated to be 50,400 cubic feet per

second. Measured at the bottom, the width of the tail-race immediately below the downstream face of the power-house is 657·5ft.; the depth below normal water surface is 23ft. The total length of the tail-race to the foot of Isle Maligne, where it joins the Grand Discharge is 800ft., of which the downstream portion of 240ft. length has a bottom width of 300ft. The maximum velocity of water in the tail-race is estimated to be 8·1ft. per second, with all twelve turbines operating at full load. Practically all of the tail-race excavation was carried out in hard rock.

Ten turbine units are now completely installed and all the parts which go into the concrete for the additional units are in place. The range in head on these turbines is between 100ft. and 120ft., and within these limits the rating of each unit is as follows :—

	Head in feet.				
	100.	105.	110.	115.	120.
Horse-power at best efficiency	35,000	37,500	40,000	42,500	45,000
Max. horse-power ..	40,000	42,500	45,000	47,500	50,000

An individual governor system operating under an oil pressure up to 220 lb. per square inch is provided for each turbine, and the piping is so arranged that the governors may be operated separately or as an interconnected system in units of four each. The governor fly-balls are directly connected to the turbine shaft below the rotor. The governor stands, gear type oil pumps, pressure tanks and receiving tanks are arranged in the spacious power-house basement or in the turbine room. An emergency stop device is installed for each turbine so as to enable the operator at the bench board to shut the turbine gates and stop any machine without the assistance of an operator in the turbine room.

Each of the generators will carry 35,000 kVA continuously at normal voltage and 80 per cent. power factor and with a required exciter capacity of 210 kW. It will also carry 24,000 kW continuously at 15,180 volts and 80 per cent. power factor. The guarantees are based on the cooling air having a temperature of 40 deg. Cent. or lower. Each generator is equipped with an upper and lower guide bearing. The thrust bearing on top of the generator is of the Kingsbury type and its housing is provided with water cooling coils.

The oiling system of each generator unit is self-contained and automatic in operation. The thrust bearing is immersed in an oil reservoir containing water cooling coils arranged on top of the upper bearing bracket. A gear pump, mounted in a smaller reservoir fitted below the lower bearing bracket, is driven by a gear on the generator shaft and forces the oil to the upper thrust bearing reservoir. Pipes also conduct the necessary oil to the two guide bearings and the overflow oil from each bearing is carried back to the lower reservoir for re-circulation.

Large brakes are provided for four of the eight arms of the lower generator bearing bracket. If operated by air pressure the brakes will stop the generator with the turbine gates closed, and if operated by oil pressure from the governor system the brakes may be used as jacks to lift the rotor. Cast iron stools are provided for mounting on the bracket arms to support the rotor when lifted.

The generator armature is star-connected and the six leads are brought out from the upstream side of the generator. By means of a 15,000-volt disconnecting switch the neutral tie is connected to the neutral bus, consisting of a ¾in. copper tube suspended by porcelain insulators from the mezzanine floor along the upstream side of the power-house, which is earthed outside the station.

The bench board is arranged on an extension of the mezzanine floor into the generator room between units No. 6 and 7. It is of the continuous closed type and has a length of 40ft. The auxiliary vertical board containing recording ammeters, voltmeters, watt-hour meters and relays is 16ft. 4in. long and 7ft. 6in. high. The control circuits are for 230 volts and the lighting circuits for 115 volts. They are placed in 1¼in. diameter pipe conduits embedded in the generator and mezzanine floors, and the estimated aggregate length of conduits in the power-house, including a number of flexible conduits, is 108,500ft.

For station use there are installed two banks of transformers which are placed in the centre of the high-tension room. Each bank consists of three 200 kVA single-phase transformers, stepping down the voltage from 13–200 to 550 volts. The two 100-ton capacity power-house cranes, the 100-ton capacity crane for lifting and transferring apparatus from the generator room to the high-tension room, the 60-ton capacity gantry crane on top of the power-house bulkhead, and the sixteen headgate hoist motors at present installed all use 230-volt direct current. The power for operating these motors is furnished by a 200-kW motor generator set. The three air compressors supplying compressed air for the governor system and the two air compressors for general station use are driven by alternating current motors at 220 volts ; power is furnished through three 25 kVA single-phase 550 to 220-volt step-down transformers. For station lighting the current is stepped down in three 25 kVA 550 to 110-volt single-phase transformers.

Method of Construction.

With the exception of some isolated bridge piers which were built by contract, the entire construction work for the Isle Maligne development was done departmentally. The work was prosecuted uninterruptedly, and while the winters were long and severe, with temperatures reaching 45 deg. below zero Fah., the snow on the ground permitted haulage on sledges, while the formation of ice on the river where the current was not too swift made it easier to build cofferdams. Beginning with November, the Saguenay River gradually falls until extreme low water is reached about the end of March. Advantage of this season was taken to build the main cofferdams and temporary rock fill dams. The procedure was to build up the cribs on the ice, then to cut out the surface to be occupied by each crib and to drop and sink the crib into position. The extreme high-water stage of the Saguenay River is reached about the end of May, flood conditions lasting until the end of June. It was therefore necessary to build high cofferdams so as to have no delay in the construction work during the late spring and to have the full benefit of the early summer season with long hours of daylight.

The power-house construction and the tail-race excavation involved the largest volume of work to be done. The first step taken was immediately to construct the cofferdams across the left channel of the Grand Discharge at both the head and foot of Isle Maligne, so as to be able to unwater the power-house foundations and the tail-race area. The upstream cofferdam was commenced in January, 1923, after a construction force had been organised. With the exception of a 200ft. long section across a high-water channel on the Isle Maligne shore, which was closed in the following July as the water subsided, it was completed in two months. This cofferdam is of the usual crib construction, rock filled with two layers of 1½in. sheathing on the upstream face. Its length is 1143ft. and its maximum height 42ft.

The cofferdam at the foot of Isle Maligne was built to shut off the backwater of the Grand Discharge from the tail-race excavation and to give a footing for a timber trestle, forming part of the construction railway system for the transportation of excavated rock from the tail-race to the crusher plant. The length of this cofferdam is 627ft.

INTERIOR OF GENERATOR ROOM

With the power-house foundations unwatered, a steel trestle of 715ft. 6in. length, carrying three lines of standard track and a runway of 43ft. 6in. gauge, to accommodate four traveller cranes, was built. This trestle covered the entire length of the power-house and the top of rail for the three tracks was at elevation 188·0, which is 50ft. above the normal tail-water level. It was completed about the end of December, 1923.

In the construction of the power-house bulkhead and substructure, the masonry was subdivided into five blocks. According to schedule, block No. 1 and the power-house bulkhead extension to elevation 197·5, containing altogether 89,000 cubic yards, were built first, so as to eliminate any possible danger from extreme high-water which cofferdam No. 1 could not safely hold back. This work was completed by the middle of April, 1924, six weeks before the river reached its highest stage. At that time the peak of the high water was within 1ft. of overtopping the cofferdam. Block No. 2, forming the power-house substructure proper, and containing 60,711 cubic yards, was completed by the end of November, 1924. Block No. 3B, of 61,474 cubic yards, by the end of December. In Block No. 3A, containing 53,961 cubic yards, the twenty-eight steel bents of the construction trestle were embedded and this work was completed by the middle of October, 1924. Block No. 4, of 39,527 cubic yards, the last portion of power-house masonry, was completed in March, 1925.

The power-house design called for a gantry crane running on top of the bulkhead, and capable of lifting any of the twenty-four head gates provided for the penstock intakes. This crane has a capacity of 60 tons when the main hoist is operated, and of 5 tons with the auxiliary hoist running. In addition, two bracket hoists of 5 tons capacity each are provided for lowering and raising stop logs in front of the rack structure. Immediately after the completion of Block 3B, the gantry crane was erected. It was used for unloading and lifting each head gate on top of the bulkhead and transferring and lowering same into position.

Spillway Construction.

The major part of Spillway No. 1, which is on Isle Maligne and forms an extension of the power-house bulkhead at right angles to it, was built simultaneously with the power-house masonry. According to the programme, the right channel of the Grand Discharge at the head of Isle Maligne was closed up on Febraury 15th, 1925 ; and the cofferdam No. 1 blown out so as to return the river flow to the Left Channel and to discharge water through two of the turbines operating temporarily under a head of 70ft. The gaps left in the masonry of Spillway No. 1 provided additional discharge capacity, so that the normal flow of the Grand Discharge could be controlled during the critical construction period when the deep foundations for Spillway No. 4 were being unwatered and the masonry built up.

Spillways Nos. 2 and 3 are in natural depressions of Isle Maligne above the present high water line, but below the final raised water level, and no special difficulties were encountered in the construction of these structures. Spillway No. 3 was completed in January, 1925.

The final control of the Saguenay River and the raising of the water to the level of the Lake St. John was accomplished by the construction of Spillway No. 4, and this work called for the most careful planning, so as to complete the structure at the scheduled date. Owing to the great depth and the swift current, it was not found practical to build a cofferdam across the right channel of the Grand Discharge immediately above the site of Spillway No. 4 to hold back the entire stream. It was, therefore, decided to go further upstream and use the channel between Barnabe Island and Isle Maligne, where much more favourable conditions for the erection of a temporary dam were encountered. This lay-out called, however, for the building of another cofferdam of 475ft. length across the so-called Barnabe channel between Barnabe and Alma islands ; but this channel was practically dry during the construction period and offered no difficulties. This arrangement made it possible to divert the river flow into the left channel of the Grand Discharge after the cofferdam No. 1 at the head of Isle Maligne was blown out, and to discharge the water through the turbines operating under a reduced head of 70ft., and through the temporary gaps left in Spillway No. 1, which accomplished the unwatering of the deep portion of the river bed at the site of Spillway No. 4 for the construction of the masonry.

During the time that these two temporary dams were being built, concrete masonry was laid from both ends of the spillway site and steel runways placed on top of each of the completed masonry sections for the accommodation of two traveller cranes which were previously used in the construction of the power-house masonry. The spillways in the three channels of the Little Discharge at the outlet of Lake St. John were constructed during the winter season of 1924–25. Several aerial views of the station are given on page 186.

Pulverised Coal Plant at the No. 3 Lister Drive Power Station.

In the articles on the No. 3 Lister drive power station of the Liverpool Corporation, appearing in THE ENGINEER of October 19th, 26th, November 2nd and 9th, it was mentioned that the pulverising plant for firing the new Babcock and Wilcox boilers were being supplied by Alfred Herbert, Ltd., Coventry. The plant consists of the firm's well-known Atritor pulverisers, which feed, dry, pulverise and eject the pulverised product, together with a percentage of primary air, direct to the Calumet burners on the combustion chambers. Four Atritors are being provided for firing each boiler, three being driven by alternating-current motors and the fourth by a direct-current motor. All the motors are being supplied by the Lancashire Dynamo and Motor Company, Ltd. This arrangement enables the boilers to be partly operated off direct-current supply, while normally operated off alternating-current supply. Each machine has a rated pulverising capacity of 6000 lb. of coal per hour with an overload capacity up to 3 tons per hour when pulverising ordinary bituminous coal. The Atritor mills differ somewhat in design from the earlier machines built by this company. In order to reduce the diametral dimensions to a minimum, each mill has two pulverising compartments, each having a separate discharge outlet, but both are fed by a common feeder and control. The arrangement will be clear on referring to Fig. 1, which illustrates the front of the machine. The feeder is to be seen situated centrally on top of the main body of the machine, and is of the rotating disc type, with two knives or ploughs, both of which are operated by the hand wheel shown on the right. The central hand wheel regulates the height of a moving sleeve, which surrounds the skirt of the hopper, and thus reduces or increases the height of the gap between the disc and the mouth of the hopper to suit the feeding qualities of the different coals being used. Fine moist coal requires a greater sleeve height than a dry nutty coal. The central lever operates a small dog clutch by means of which the

feeder can be instantaneously stopped when it is necessary to do so.

From the feeder the coal descends to the respective pulverising compartments, first passing through a metal separator for eliminating any foreign bodies heavier than coal. This device works on the well-known winnowing

FIG. 1 FRONT VIEW OF ATRITOR PULVERISER

principle in which a current of air acts as the selecting medium, the velocity of the air current being only sufficient to carry the coal into the mill, and any foreign bodies heavier than coal are ejected down the large central port near the base of the machine. The separators are fitted with quick-lock doors having glass fronts, so that the

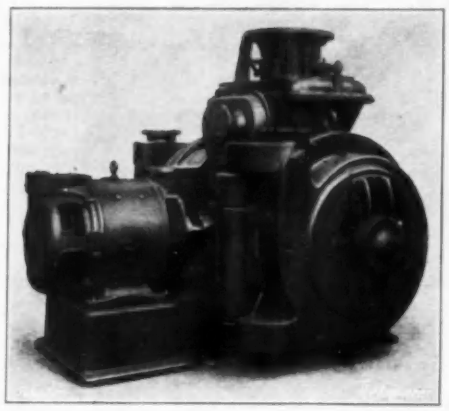


FIG. 2—DRIVING ARRANGEMENTS

flow of coal into the mill can be seen at any time. For the reception of any tramp iron that may inadvertently enter the pulverising compartment, a tramp metal pocket of adequate capacity is provided at the base of the pulverising chamber, access to which is gained by removing the cross bar and jack screw, which can be seen near the

FIG. 3—FEEDER DRIVE

floor line, and the tramp metal pockets can be emptied while the machine is in operation. Hot air which is required for drying the coal during pulverisation is admitted through a duct in the base of the machine, and is controlled by butterfly dampers. Large and easily removable inspection covers are fitted to the pulverising chambers, so that the condition of the pulverising elements can be examined without the necessity of opening up the whole of the mill. The driving arrangements can be seen on referring to Fig. 2.

The motor is mounted on a pedestal securely bolted and dowelled to the base of the machine, the drive from the motor to the main shaft being through spiral bevel gears, which are lubricated by means of an oil jet. The motor pedestal forms an oil container, and immediately behind the motor there is a cover which houses a chain

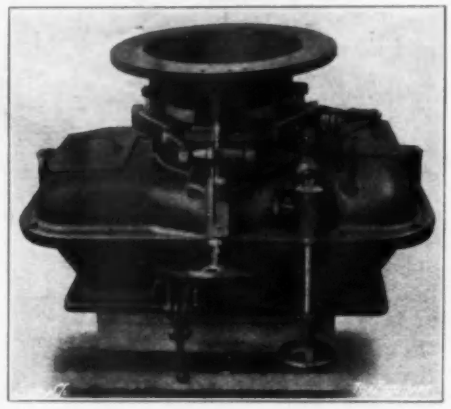


FIG. 4 FEEDING MECHANISM

drive and force feed pump which delivers oil for lubricating the gears, the feeder and chain drives. The feeder drive—shown in Fig. 3—is driven by Westinghouse Morse rocker chain, the final drive in the feeder box being by worm and worm wheel. The oil is delivered to the base of the feeder and from thence overflows over the chains lubricating the primary shaft bearings, and then drains back to the sump. The construction of the feeder will be clear from Fig. 4, which shows the operating mechanism with the covers removed.

The internal construction of the mill will be seen from

FIG. 5—INTERNAL CONSTRUCTION OF ATRITOR

Figs. 5 and 6. The Atritor is a two-stage pulveriser, the primary stage being that of disintegration, in which the coal is disintegrated by means of rotating hammers. This construction will be seen from the former illustration, two of the hammers being plainly visible, the rotor disc having been removed for this purpose. After disintegration the particles pass over the edge of the rotor and inwards to the centre on the opposite side to the disintegrating chamber, the rotor thus dividing the pulverising operation into two stages. In the second stage the coal is subjected to a com-

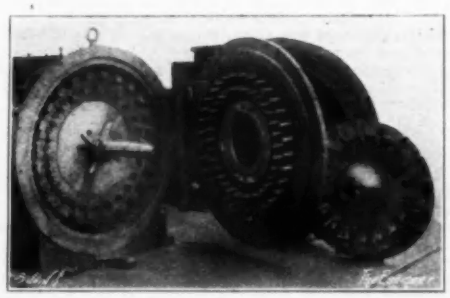


FIG. 6—INTERNAL CONSTRUCTION OF ATRITOR

bination of centrifugal and centripetal forces, the rotating elements tending to force the larger particles outwards, while the fine particles are slowly sifted by means of the fan stream. These particles are subjected to further eliminating treatments by the rejectors which are mounted on the hub of the rotor, and the fine particles which pass the rejectors emerge through the centre opening into the fan chamber, whence they are discharged direct to the burner.

The chamber for the collection of tramp metal will be seen at the base of the pulverising compartment. The rotor consists of a steel disc, upon which replaceable segments are bolted. These segments also form wearing plates which eliminate the wear on the steel rotor disc, which formerly was a serious item of maintenance. The construction also gives much longer life than hitherto, and replacements are very quickly and easily effected.

The unit mill of this type, when dealing with normal bituminous coal, should pulverise from 8000 to 10,000 tons without requiring replacements, the life naturally depending to some extent on the hardness of the coal. All the wearing parts, such as liners, fan blades, &c., are designed to be very quickly and easily replaceable, and the question of rapid access to the machine has been specially studied, so as to reduce the time of making replacement to a minimum.

Water-tube *versus* Scotch Boilers.*

IN a paper read before the Liverpool Engineering Society on Wednesday, January 30th, Mr. J. Austin, M. Inst. N.A., the superintendent engineer of the Cunard Steamship Company, Ltd., dealt with the present position of the water-tube and Scotch marine boiler, with particular reference to the difficulties which are encountered in the operation of these boilers at sea.

He pointed out that the water-tube boiler has a maximum of power for a minimum of weight, with the additional advantage of quick steam raising, both of which features were essential in naval vessels. In the mercantile marine, on the other hand, the propelling machinery was required to give a uniform speed the whole time the vessel was at sea, and her engines and boilers were designed for maximum efficiency at that speed. Units of power were considered in strict relationship to units of cost and upkeep, and reliability over extended periods was regarded as being more essential than reduction in weight. Marine engineers were now faced with a new proposition, for whereas in the past the water-tube boiler was used in naval vessels for the reasons above enumerated, it was now being adopted on a large scale in the merchant service mainly on account of its ability to withstand higher pressures, the object of which was to improve the overall efficiency of the plant and to reduce the fuel consumption.

This sudden adoption of water-tube boilers gave cause, he thought, for consideration and reflection, and the questions might be put, Had all difficulties in the operation of water-tube boilers and their upkeep been overcome? Were they suitable for all types of ships and all services? Were they as efficient as the Scotch boiler?

In order to review the main features of both types, Mr. Austin proceeded to take for purposes of comparison a Scotch multi-tubular boiler and a three-drum straight-tube water-tube boiler, both oil fired, types of steam generating plant with which he has had considerable experience.

In tables given by the author, service evaporation tests on three double-ended Scotch boilers and twelve water-tube boilers, for both outward and homeward voyages, were set out, and heat balances drawn up. The following is a summary of the results:—

	Scotch boilers.		Water-tube boilers.	
	B.Th.U.	Per cent.	B.Th.U.	Per cent.
Gross calorific value of fuel used (by bomb calorimeter)	18,277	100·0	18,300	100·0
Heat transferred to water ..	15,024	82·2	13,908	76·0
Heat lost by H_2 burning to steam	1,077	5·89	1,050	5·74
Heat lost in excess air used ..	214	1·17	210	1·15
Heat lost in flue gases	875	4·78	882	4·82
Heat lost by incomplete combustion	11	·06	56	·30
Heat by radiation, &c.	1,076	5·9	2,194	11·99
Total	18,277	100·0	18,300	100·0
Equivalent evaporation per square foot of heating surface per hour, lb. .. .	7·09 to 7·28		5·4 to 6·8	
Thermal efficiency on gross calorific value, per cent. ..	81·06 to 82·27		74·2 to 76·0	

These results, obtained under service conditions, went to show that, notwithstanding the fact that the rate of evaporation was lower in the water-tube boilers, the results obtained were not as good as those for the Scotch boilers.

The Scotch boiler was designed for a working pressure of 195 lb. per square inch, and although very efficient it could not be taken as illustrating the latest practice, as a larger air heater might have been fitted and a higher steam pressure adopted. The water-tube boiler was typical of that used up to late years in the largest passenger ships of the mercantile marine. It was a three-drum type, the top cylindrical drum being furnished with a steam dome and the bottom two drums of "D" shape heavily stayed internally. A large downcomer tube was fitted between the top and bottom drums at the front end of the boiler. The tubes were 1¼in. in internal diameter, and there were five oil burners; the boiler worked on the closed stokehold system.

In the case of the Scotch boiler, it was noted that a comparatively large area of heating surface was exposed to the hot gases of combustion in their incandescent state in the furnace and the combustion chamber. Actually this area was about 17·8 per cent. of the total heating surface of the boiler. In the water-tube boiler, which was of practically similar horse-power and heating surface, that percentage was only 6·6. Actual tests—for which figures were given—showed that in a Scotch boiler the ratio of the heat given up in the furnace and combustion chamber to the total heat given up, was of the order of 72·5 per cent.

It appeared, Mr. Austin went on to say, that the Scotch boiler, either by chance or design, was arranged to provide larger areas of more or less plain heating surface than the water-tube boiler, in the regions where heat was mainly

* Liverpool Engineering Society, January 30th. Summary.

ENDLESS-ROPE SEWAGE SCREEN AT DAVYHULME DISPOSAL WORKS

F. W. BRACKETT AND CO., LTD., COLCHESTER, ENGINEERS

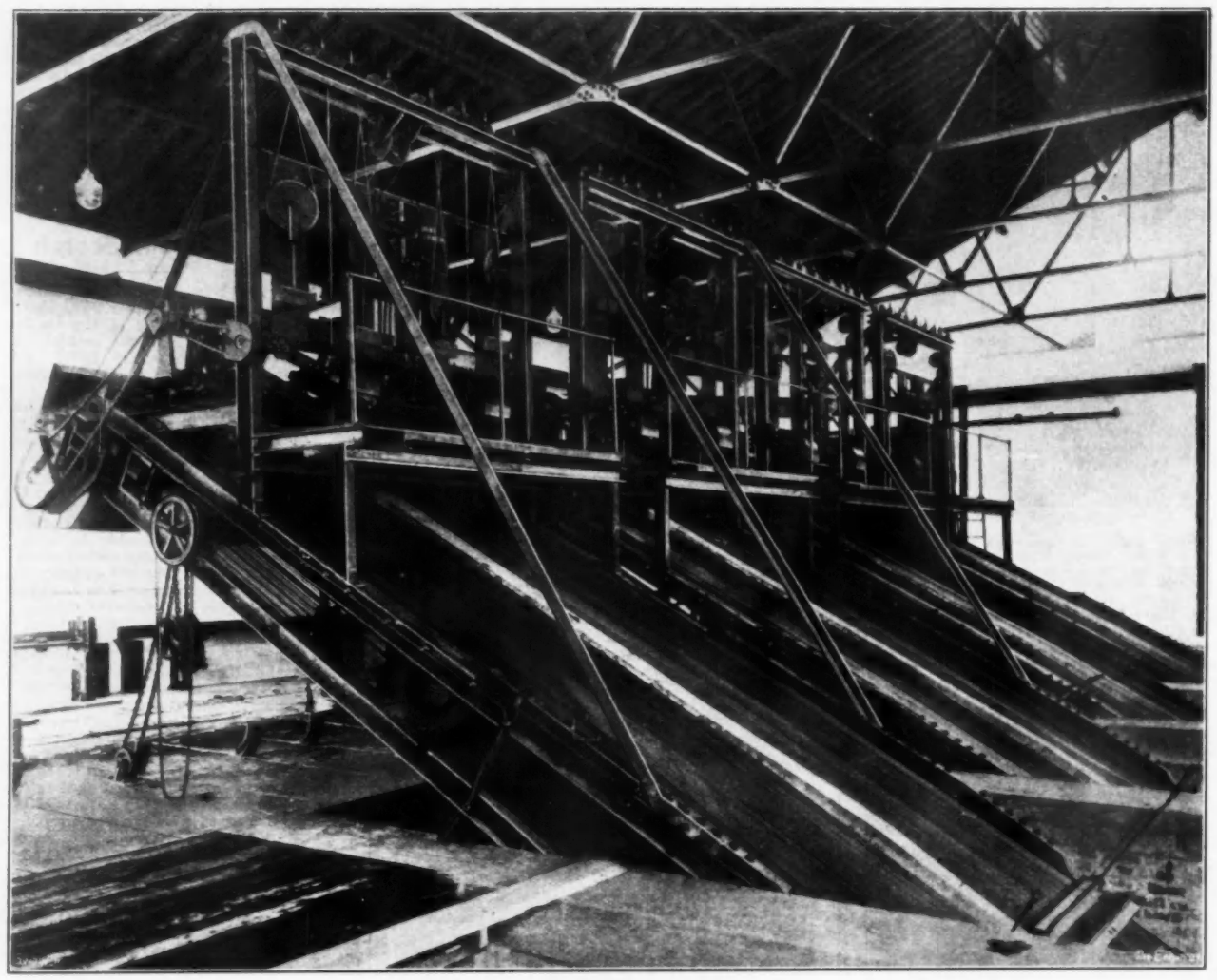


FIG. 1

transmitted by radiation. This was important for cleaning and upkeep, since scale was deposited in the Scotch boiler on a surface from which it was more easily removed, and being outside the tubes was more readily observed.

Comparing the steam and water spaces, Mr. Austin pointed out that the single-ended Scotch boiler contained 32 tons of water, which at the working level was 7½in. above the top of the combustion chamber. The steam capacity of this boiler was equal to 50 per cent. of the water capacity. In the water-tube boiler the amount of water was 9 tons and the steam capacity was 43 per cent. of the water capacity. There was very little difference, therefore, in the ratios of the steam to water capacities in the two types of boiler, but there was an important difference in that the steam space of the one type was 4·2 and the water capacity 3·6 times that of the other.

Mr. Austin, while admitting that the water-tube boilers were of an old design, held that the principal losses were through the boiler casing and the high funnel temperature. In his opinion, the reason why the Scotch boiler was such a good steam generator was that the combustion space was entirely jacketed with water. And the boiler shell, which was at the steam temperature, could be easily insulated to prevent loss of heat.

The two boilers referred to in the paper were installed, he said, in ships of the same type and in the same service. They were built in 1913, and with the exception that the vessel with the water-tube boilers was laid up for several years during the war, both ships had been on the same service from that year until now. Mr. Austin stated that he had no records of the way in which the water-tube boilers were treated during the first seven years of their life.

With regard to upkeep and repairs, the vessel with Scotch boilers had 21 boilers and 168 furnaces, but only one of these had had a furnace renewed, which was necessary because of an original defect in construction. The cost of boiler repairs in this ship had therefore been practically nil. The 46 water-tube boilers in the other vessel had had, on the contrary, all their tubes completely renewed, and a considerable number of them renewed for the second time. Mr. Austin did not deal with the defects which might occur in the cleaning of Scotch boilers, as, he said, marine engineers were familiar with those points, but he went on to describe the type of tube failure in the water-tube boilers and the causes. Tube failures might be due to internal corrosion, buckling and bending, external corrosion, and bursting. The operation of boiler cleaning was expensive, but the cost had been reduced by paying special attention to the fire row tubes, in which most of the scale was deposited, and in which most of the buckling and bursting occurred. The renewing and the repairing of the refractory material was another heavy item.

The treatment of feed water was then discussed, and particulars given of the water-softening plants installed on the "Berengaria" and "Mauretania."

In conclusion, Mr. Austin remarked that in order to demonstrate the suitability of water-tube boilers to withstand high pressures, boilers operating at 1500 lb. per square inch pressure were now being built. On the other hand, the Scotch boiler appeared to have reached its limit at a pressure of 300 lb. per square inch. Whereas a Scotch boiler could have an evaporation of 60,000 lb. of water per hour, water-tube boilers were being constructed for land purposes with evaporations of up to 300,000 lb. per hour, with 750 deg. Fah. steam temperature and the air preheated up to 350 deg. Fah. It would seem, however, that the limit of evaporation in marine type water-tube boilers was roughly the same as that of the Scotch boiler, the size being limited by the space available on the ship.

It appeared to be impossble to lay down any fixed rule that water-tube boilers were suitable in all cases. It was the task of the owners or their technical representatives to weigh up the merits of each type of boiler for the service it had to be engaged in before a conclusion could be reached as to which was the most suitable type of boiler. Wherever water-tube boilers were chosen for a vessel, it was essential that the engineering staff on board should be given a thorough training in the chemical testing and treatment of the feed water in order that justice might be done to the boilers. If the water-tube boiler was treated with as little care as the Scotch boiler had been in the past, then its life would not be a long one. If, however, due care was taken there was no reason why it should not be successfully operated, but the owners of the tramp type of vessel would be well advised to stick to their tried friend, the Scotch boiler.

A RECENT issue of *Nature* contains a brief account of the methods used by the United States Coast and Geodetic Survey for the measurement of the depth of sea water. For soundings in water too deep for the hand line the sound-wave method in the form known as the "fathometer" is mainly used. An electrically-driven oscillator strikes a diaphragm under water outside the ship and the sound reflected from the bottom of the sea affects a microphone in a water tank inside the ship's plating below water level. In series with the microphone is a neon tube which lights up when the reflected sound arrives at the microphone. The tube is placed behind a radial slit in a revolving disc in front of which is a circular dial marked in fathoms. The oscillator acts as the neon tube passes the zero of this scale, so that the depth is read at the end of the revolving slit when it flashes out red owing to the lighting up of the neon tube behind it. The speed of sound in sea water of salinity 35 parts per 1000 at the surface and at 0 deg. Cent. is taken as 1450 m. per second. It increases 4 m. per second per degree rise of temperature, 3 per 100 fathoms depth, and 1 per part per 1000 increase of salinity.

A New Type of Sewage Screen.

THE effective screening of sewage has always presented difficulties for the raking type of screen which has hitherto held the field almost entirely in this country. With this kind of screen not only must the cleaning rakes be strong and substantial, but the working clearance between the bars of the grids which they clean must be allowed for. Further, the movement of the rakes themselves over the grids disturbs a large proportion of the solids resting on the grids, and the rubbish that is dislodged passes through the grids with the screened sewage. To overcome these troubles, F. W. Brackett and Co., Ltd., of Colchester, have designed and constructed an entirely original type of screen, of which illustrations are given in Figs. 1 and 2. Four of these screens have been installed for dealing with the sewage of Manchester at the Davyhulme works, where the dry-weather flow amounts to 80,000,000 gallons per day. Before the contract was placed for these screens exhaustive experiments were carried out on a large scale over a period of sixteen months, and for that purpose an opening was made in a 13ft. sewer, in which a screen 8ft. wide was placed. The sewage was passed through the screen just as it came from the city, without either settlement or rough screening. The result of these experiments was entirely satisfactory, and the four screens were duly ordered and are now in daily use. They operate in sumps which are 9ft. 6in. wide between walls.

With the activated sludge process of sewage treatment, which is in operation at Davyhulme, it is necessary, for the sake of economy, to screen through a very fine mesh; it is also necessary, for facilitating disposal, that the screenings should be taken to the dump in a dry condition. The screening medium of the new rope screen consists of continuous wire ropes wound helically round top and bottom drums at the extremities of the screen frame. These drums consist of a series of grooved pulleys, each of such a width as to give the required opening between adjacent ropes. The ropes are endless, and the tension on them is maintained by weights suspended from pulleys arranged to form a loop above the level of the sewage in which loop the weighted pulley hangs.

All the separate pulleys comprising these drums are free upon the shaft on which they are mounted, with the exception of two upon the upper shaft, which are keyed to the latter, in order to drive the ropes. The pulleys being free on the shaft, lateral movement amongst themselves to compensate for irregularities in the rope brought about by slight variations in its diameter or to rubbish clinging to it, is permitted. By this means, the makers claim, an even tension is always maintained over the whole of the ropes.

The top and bottom drum shafts are synchronously driven by electric motors and pitch chain, and the only movement of the pulleys upon the shafts is, therefore,

due to compensation on account of the irregularities mentioned above.

We understand that since these movements are exceedingly small, wear in the bore of the pulleys and upon the shafts is negligible.

The rope drums are mounted in substantial frames which lie at a flat angle and fit closely to the sides of the sumps, in which they are situated. The sewage flows through the spaces between the adjacent ropes and the rubbish is entrained upon the ropes, by which it is carried upwards out of the flow of sewage without disturbance. Passing upwards, the rubbish is carried over the top drum and is discharged into trucks arranged to come below the head of the screen.

The cleaning of the ropes before they return along the underside of the screen into the sewage is effected by pulley. These brushes—the arrangement of which is shown in Fig. 3—have a cutting effect upon the fibre, and the rope is therefore cleared of this material.

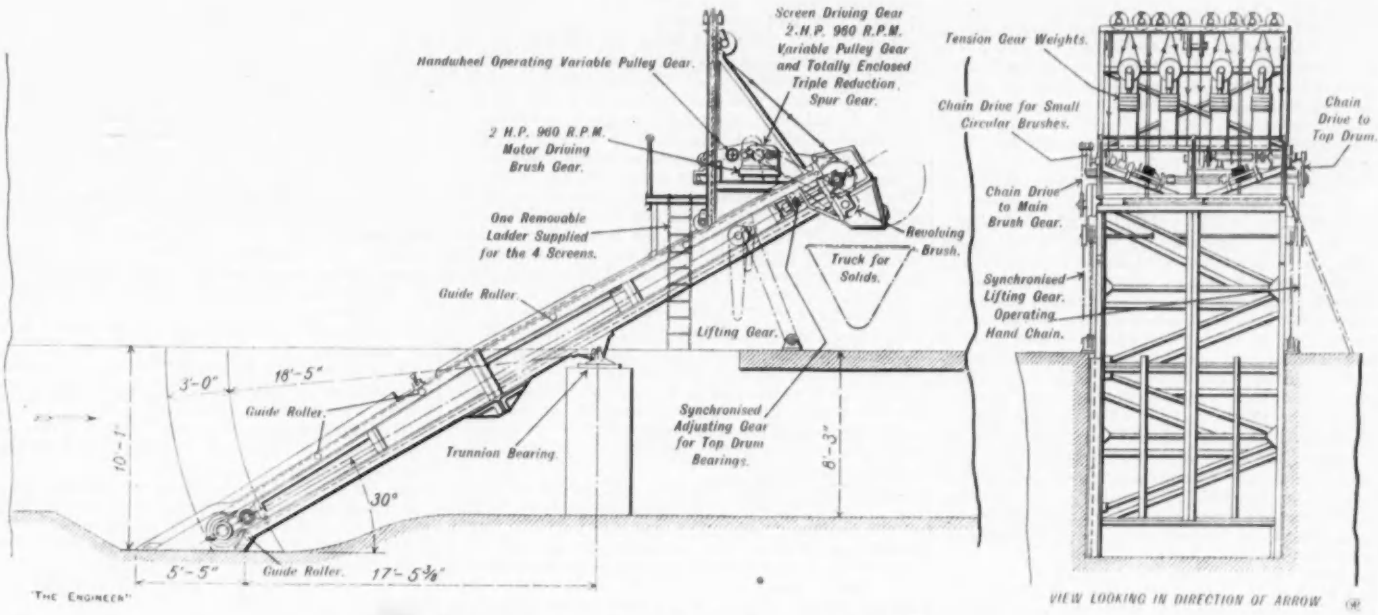


FIG. 2. ARRANGEMENT OF ENDLESS-ROPE SEWAGE SCREEN

The spacings between the ropes and the front or incoming side of the screen are accurately maintained by grooved rollers underneath the screen face, these rollers being also driven at the same speed at their circumferences as that at which the rope is travelling by means of chains which synchronise the speed of the top and bottom drums. The ropes on the underside of the screening medium are without support between the top and bottom drums and have considerable swinging movement, which leaves wide spaces between them and prevents the possibility of small rubbish which has passed between the ropes on the screening face from being retained on the inside of the screen. A grooved roller at the bottom of the screen ensures that

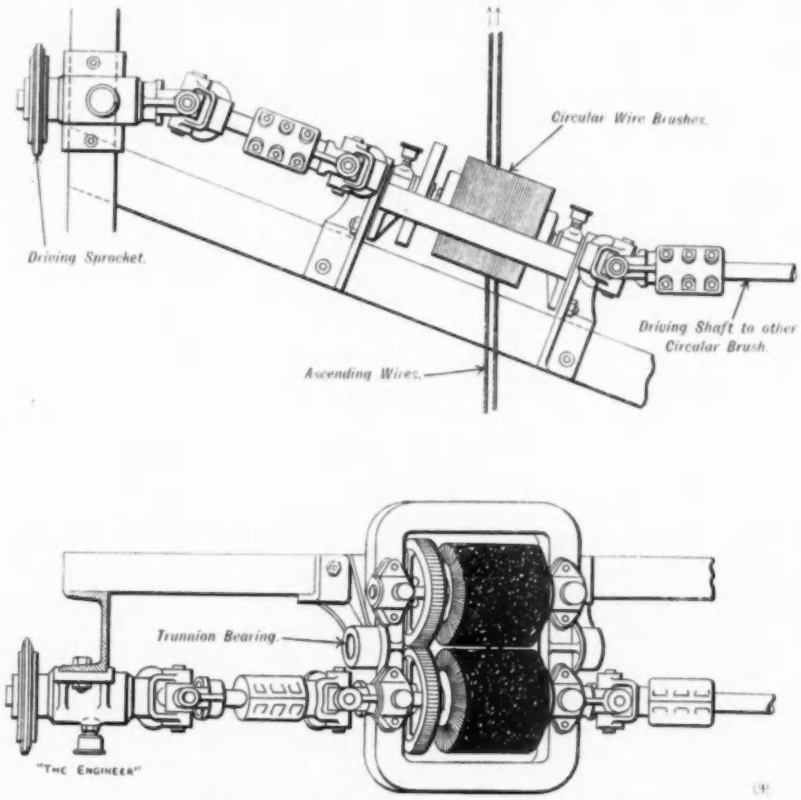


FIG. 3.—ARRANGEMENT OF BRUSH ROPE-CLEANING GEAR

brushes arranged just at the point at which the ropes leave the grooved pulleys. These brushes consist of ordinary bass broomheads of good quality attached at intervals round the sides of a square shaft. They can be removed and replaced in a few moments when it is necessary to change them. The brush shaft is rotated at such a speed that the rubbish is thrown off the bristles by centrifugal force, the brushes in that way being, themselves, kept clean.

In some districts the sewage is heavily charged with cotton fibre and hair, which becomes wrapped round the ropes, and in such cases additional brush gear, consisting of small steel rotary brushes, is provided to brush the rope as it ascends over the pulleys that carry the tension weight

the ropes on the returning side shall be accurately guided into their respective grooves on the bottom drum.

The screens are operated electrically, and the speed of the ropes can be varied in accordance with the amount of rubbish which is met with. The screen frames are mounted on trunnions, and lifting gear is provided so that the whole screen may be swung up above water level in a few minutes for examination or repair.

The ropes are made of any required length up to 5000ft., and the ends are joined by a long splice. The screens at Davyhulme have each four ropes, 4800ft. long. They are very flexible and consist of seven strands, each containing seven wires, the outside diameter of the rope being $\frac{1}{4}$in.

We are informed that, owing to the fact that the bristles of the cleaning brushes have a strong affinity for the grease which is present in sewage, the ropes, which are of special make, are not detrimentally affected by the action of the grease.

SIXTY YEARS AGO.

THE campaign to secure economy in the administration of the nation's affairs with which Mr. Gladstone began his first Government was enthusiastically supported by several sections of the Press and people, but among others, including ourselves, doubts were expressed as to the wisdom of some of the proposed steps. As indicated in this note a fortnight ago, we were opposed to the abolition of factory inspectors, one of the minor measures of economy suggested. In our issue of February 12th, 1869, we assumed a facetious tone concerning the steps being taken to secure economy in the administration of the Navy. We stated that a circular to all the engineers and assistant engineers was being prepared at the Admiralty, and that although we had not seen it we were in a position to indicate its general purport. We may reproduce a few of the items in this alleged circular, less for the sake of their humour, which was far from despicable, than for the sake of the light which their very exaggeration throws on the conditions of naval engineering service sixty years ago. My lords were impressed by the fact that in her Majesty's ships 3 lb. to 4 lb. of coal per indicated horse-power hour were burned, while in Cornish engines the consumption was only from 2 lb. to 2½ lb. They therefore commanded that in future not more than 2 lb. per indicated horse-power hour were to be consumed. As a stimulus to deserving engineers they would allow a bonus of one halfpenny per 100 tons of coal saved under the new regulation, one half to go to the captain, a quarter to the ship's medical officer, and a quarter to the Inspector of Machinery afloat. Three and four-bladed propellers were to be reduced to two blades. The metal removed was to be sold to marine store dealers at 4d. per pound. Ashes were not to be thrown overboard. They were to be collected and sent to London by rail, where they could be sold for 6d. a ton to brickmakers. In place of Bourdon steam and vacuum gauges, costing £4 each, Birmingham wire gauges were to be fitted to all boilers and condensers in the Navy. Such gauges, it was added, cost only 5s. each and were exceedingly accurate. A vacuum of at least 30in. was to be maintained in all condensers except on Sundays and Christmas Day, when 29in. would suffice. The pumping of water into boilers by means of donkeys was regarded by my lords as a reprehensible practice. A sea life was not suited to these animals, and as they were understood to cost £100 apiece a little ingenuity exercised for their abolition might materially reduce the naval estimates. The practice of burning fire-bars in order to raise steam quickly was prohibited. Iron was a most expensive fuel. Following the admirable practice inaugurated at Somerset House, my lords would in future make no allowance for engine-room cats. On and after a day to be named only one engineer was to be allowed to every two of her Majesty's ships when at sea. Once an engine was started it required only to be left to itself. The surgeons being men of scientific attainments, could easily be instructed how to stop the engines in case of necessity.

A "COMING OF AGE" CELEBRATION.—On Thursday, February 7th, there was celebrated the twenty-first anniversary of the foundation of the firm of F. and A. Parkinson, Ltd., of Guiseley. This business, which recently amalgamated with Crompton and Co., Ltd., was founded by Mr. Frank Parkinson on February 7th, 1908. The event was commemorated by a party, held at Horsforth, Leeds, which was attended by 450 members of the staff of the Guiseley works and offices. The party was preceded by a complimentary dinner at the Queen's Hotel, Leeds, to the employees of over ten years' service. During the remainder of the evening there were dancing and a theatrical performance, and advantage was taken of the occasion by the management to make special presents to the three members of the staff having the longest records of service with the company.

The Electrical Research Association

SPEAKING at the annual luncheon of the British Electrical and Allied Industries Research Association, Ltd., held at the Savoy Hotel on Friday, February 8th, the new President, Mr. C. P. Sparks, said that having been connected with the Association since its inception as a member of the Council, representing the Institution of Electrical Engineers, he naturally took the keenest interest in its development. Prior to the formation of the E.R.A., both the B.E.A.M.A. and the Institution of Electrical Engineers had each of them started co-operative research on a small scale, but whilst valuable work was carried out in one or two directions, it was soon recognised that the funds available were quite inadequate to handle the many problems requiring investigation. The E.R.A. owed its existence primarily to three sources. First and foremost, to the manufacturers in guaranteeing £8000 a year for the first five years of the Association's existence. Secondly, to the Department of Scientific and Industrial Research, which contributed pound for pound during the initial period; and, thirdly, to the large body of voluntary workers who controlled the individual researches under the supervision of the Association's Director. That gave him the opportunity of emphasising the courage of forethought of the B.E.A.M.A., and cable manufacturers' association, who found that considerable sum during a period not blessed with general prosperity, and who still found the bulk of the funds.

The main object was to undertake co-operative research in all matters affecting the electrical industry, including problems affecting both the manufacture of plant and the supply of electricity outside the capacity of individual undertakings. It was important to note that co-operative research undertaken to benefit the community as a whole was entirely distinct from independent research carried out by individual firms, and he was pleased to note that, in the opinion of the Department of Scientific and Industrial Research, the general trend of co-operative research had been to encourage independent private research. The main organisation consisted of a Council, the Director, the National Physical Laboratory, twenty universities and colleges, a large number of industrial undertakings, and some 300 individuals, who were gratuitously giving their time and expert knowledge. The mainspring of the organisation was the Director, Mr. W. B. Wedmore, and the Association was indeed fortunate in having an enthusiast who was at the same time a man of exceptional ability, both as a technical engineer and a business organiser. The organisation, so directed, could profitably undertake many additional researches, and its operation on a larger scale would lead to even greater efficiency. During the last eight years approximately £160,000, or an average of £20,000 a year, had been expended, the present rate of expenditure being £25,000 per annum. But the real investment was represented by a much larger figure, and it was supplemented by the valuable service of some 300 voluntary workers and the use of plant and facilities afforded by some of the large supply undertakings and manufacturers.

The principal results so far secured were mainly of value to the electric supply section of the industry. The results had effected a saving in capital expenditure, maintenance and running costs; the annual saving arising out of the E.R.A. from seven researches was estimated to result in a saving approaching one million pounds per annum, the seven researches being upon underground cables, insulating material, insulating oil, dielectrics, overhead transmission, switchgear, and control apparatus, and steam turbine nozzles. Other important researches had, of course been carried out, but those mentioned were most closely associated with the supply industry. This country lived by export trade, and owing to the high standard of living, high wages and heavy taxation, overseas sales were dependent on producing the best article. Hence, any development which tended to improve knowledge and place British manufacturers ahead of those in other countries was of vital importance. Whilst that was of primary importance to British manufacturers, it was also important to the supply industry, because any trade reaction directly affected the supply of electricity. As the scale of operation at home was small as compared with some of the great world undertakings, it might be expected that British delegates attending international conferences would take a secondary position, but through the work of the E.R.A. and associated bodies, the position of engineering delegates representing this country had been greatly strengthened, and as a result of first-hand information had enabled them to take a leading position. In general, the opinion of British delegates had been endorsed by those international conferences. That had been a factor in expanding this country's overseas trade. If there were any doubts as to the international opinion on research, the views expressed by Signor Mussolini at Rome a few days ago would set them at rest. Speaking at the inauguration of the National Council of Scientific Research, he had insisted on the necessity for close co-operation between the producing classes and the new Institution, which was destined to expand the aids of science to the common good. In conclusion, he had remarked that "the richest nations were those which understood the value of intensive scientific research in industry, agriculture, and national defence."

The last report of the Department of Scientific and Industrial Research recorded that certain researches of the E.R.A. had been curtailed or suspended for the lack of funds. That had been the position for the last two years, and the 1928–1929 programme involved an expenditure of £36,000, which the staff organisation was well able to handle, had been curtailed to £25,000. To meet the whole position, an important conference was held in June last, when Sir Richard Glazebrook, who was in the chair, asked if the Association was to go on with increased means. Had it, he asked, proved of sufficient value to the industry, to the country, to users of electricity, and to practically all of us, to make it worth while that the scheme of work which had been developed during the past six or seven years should be continued on a larger scale than before, with more full and more complete support from the various branches of the industry? Important resolutions were passed at the conference, including extension of the present scale of expenditure of £25,000 per annum, to double it within five years, and to widen the articles of association so as to give adequate representation to all contributing interests. The whole matter was under consideration by a committee representative of all the interests concerned.

Referring to funds required, Mr. Sparks said that from the conference of last June £50,000 per annum should be found within the next five years. In 1928 £5000—one-fifth of the Association's income—had been derived from the supply section of the industry, the E.R.A. being supported by statutory undertakings, which supplied 95 per cent. of the units sold. While the proportion which should be found by each section of the industry was the subject of inquiry by the committee appointed last June, he could not but feel that the supply section—subject to adequate representation on the Council—should find a much greater proportion in future. The investment in the electric supply industry at home was over £300,000,000, while the gross revenue was some £45,000,000 per annum, and if one-tenth of 1 per cent. were contributed to the E.R.A., sufficient funds would be available for a full programme. Any such expenditure made by the supply undertakings would ultimately fall on the public, who would be recouped by improved service, increased reliability, and ultimately lower cost. In their latest report the Electricity Commissioners had set out the necessity for research as a contributory factor to the progressive development of electricity supply, and additions to the Commissioners' remarks were unnecessary. In conclusion, he would ask those controlling the expenditure of each and every supply undertaking to read the eighth annual report of the E.R.A., including the foreword by the hardworking Chairman, Mr. R. W. Paul, and then give such increased support as would enable the Association to carry out its full programme.

Literature.

Proposed London and Paris Railway. By WILLIAM COLLARD. London: P. S. King and Son, Ltd. Price 10s. 6d.

THE earliest proposals for a tunnel under the Channel date back before the days of railways. One was placed before Napoleon in 1802 by a mining engineer named Mathieu. He was followed the next year by de Mottray, who suggested an iron tube resting on the bottom. Some forty years were devoted to the subject of cross-Channel communication by de Gaumond, who died in 1876. After considering a submerged tube, a train ferry and a bridge, he decided on a tunnel, one design for the latter involving the formation of thirteen artificial islands, through which shafts were to be sunk.

Many schemes have been put forward from time to time which came to nothing. One was due to Zerah Colburn, who produced plans for a tube made in 1000ft. sections, attached to each other by ball and socket joints. In reviewing a book published in 1861, describing another proposal for an iron tube, by James Chalmers, THE ENGINEER said: "We know of no good reason why the construction of a submarine tunnel, 20 or 30 miles long, should prove an impossible undertaking." Still less is it impossible at the present day, and there are many signs of a considerable revival of public interest in the subject.

The scheme put forward in the book under review is one of great interest, whether we take it seriously or not. It is to construct an electric railway of 7ft. gauge all the way from London to Paris, at a cost of approximately £200,000,000. The principal tunnel is to be nearly 44 miles long, and there are eight others, aggregating over 12 miles. The speed is to be 120 miles an hour in the country; 90 in the approach tunnels; and 60 in the main tunnel; the time occupied being 2¾ hours.

The chapter dealing with the subject of gauge gives the results of calculations which show the superiority of the broad gauge from the point of view of deadweight. They are no doubt perfectly sound; there is also the great advantage which would be gained in designing the locomotives; but, one cannot accept the idea of a break of gauge at any price.

Stress is laid on the inconvenience that would be felt by English railways if their stock were allowed to run about all over the Continent. But the best way to meet this difficulty is for an independent company to be formed, on the lines of the International Sleeping Car Company, to provide the necessary passenger and goods stock and control its circulation.

It is argued that all passengers and goods must leave the train for Customs examination, and that consequently the change to other vehicles is not objectionable. But even at present one's hand luggage is examined on the "Blue" trains, and the practice would no doubt be extended, if it were no longer necessary for passengers to alight. Heavy luggage need not be touched until the end of the journey, wherever that may be; and with regard to goods, many consignments could go through intact in sealed vans, and be dealt with at the final destination. Packages passing between the Continent and America need not be opened in this country. We have no hesitation in saying that if this line were to be built on the broad gauge, it would be converted to standard before five years had passed, owing to the outcry which would be raised.

The question then arises, is it worth while for the sake of the extra speed to duplicate the existing railways? The present line from London to Dover could be enlarged to the international loading gauge for about £3,000,000, which would allow the great European expresses to start from London instead of Calais; and in course of time further improvements could be made in the way of flattening out curves and gradients. Electric traction would eventually come, and with trains carefully designed with a view to air resistance, the present speeds could be very materially improved upon, without the expenditure of all the millions of money necessary for the proposals under review, to say nothing of the sterilisation of about 2000 acres of land.

The chapter on high-speed traction has evidently been written without reference to the most recent authority, and some of the figures for resistance are of more than doubtful validity, one or two of them erring on the high side. On the other hand, the additional resistance due to oblique winds is dismissed as negligible on the old theory that they merely cause flange pressure, which is now completely discredited.

It is not proposed to exceed 20 tons per axle, a restriction which rather suggests that the full possibilities of the 7ft. gauge would not be utilised; certainly they would not, if steam traction was to be used.

The chapter on traffic promises dividends of 5 per cent. on debentures, 6 on preference and 7 on ordinary stock. These returns are to be earned by virtue of a multiplication of through passengers by 2 for the tunnel, and 2½ on the top of that for the increase of speed, making the traffic five-fold. One can admit the first increase—the reviewer has been told by a friend who has the best possible authority to speak on the point, that very large numbers of foreigners are deterred from visiting England by their dread of the crossing—but to assume a further 150 per cent. on account of the saving of time is rather too much to ask us to believe. The trip will be far more unpleasant than an ordinary journey by train. No one will enjoy 56 miles of tunnel. The noise—about which nothing is said, although it is rather an important point—will be terrible. Probably it could be materially reduced by lining the tunnel with some sound-absorbing material, but, of course, such an expedient would be very costly.

There is also the local traffics in England and France to assist, which are reckoned at £1,500,000 and £2,250,000 respectively. These figures are not much more than guesswork.

In anticipation of a somewhat cold welcome from the Southern Railway of England and the Northern of France, attempts are made to show that they will obtain increased business in other directions, but the proffered consolation is scarcely likely to disarm their natural opposition.

The rest of the book is mainly taken up with the military aspect of the question, which need not be dealt with here. No engineer, and at the present time probably only very few soldiers, would have any apprehensions on the subject, since the tunnel could be rendered temporarily useless by turning a handle or pressing a button.

The book is well produced, and, on the whole, well worked out. The industry which has gone to its making is to be admired; but the scheme is on altogether too extravagant a scale to be accepted as a practical one.

BOOKS RECEIVED.

Industrial Lighting. London: The Benjamin Electric, Ltd., Brantwood Works, Tottenham, N. 17.

Construction of Alignment Charts. By G. W. Swett, London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 10s. net.

Forest Products Research Bulletin No. 2: Lyctus Powder-post Beetles. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. net.

Statistical Mechanics: The Theory of the Properties of Matter in Equilibrium. By R. H. Fowler, M.A. London: The Cambridge University Press, Fetter-lane, E.C. 4. Price 35s. net.

Railway and Road Matters.

THE National Steel Car Company, of Hamilton, Ont., has been given an order by the Canadian Pacific Railway for the construction of 2300 all-steel freight cars representing a value of approximately 7,000,000 dollars.

THE position of superintendent marine engineer, Euston, of the London, Midland and Scottish Railway, made vacant by the sudden death of Mr. David Gibson, has been filled by the removal from Heysham of Mr. A. T. Cotton.

THE commodity statistics dealt with in the Ministry of Transport railway statistics for October last are those in respect of coal, coke and patent fuel. They give the most recent particulars regarding the tonnage, receipts and receipts per ton-mile. Separate figures are given for land sale and for shipment traffic, and of the amount carried in railway owned and privately owned wagons.

THE London, Midland and Scottish Company had to record another fatal collision early in the morning of Tuesday last. The 9.30 p.m. from St. Pancras to Glasgow ran into a goods train near Doe Hill, on the Erewash Valley branch. The driver and fireman of the express were killed, but there were no personal injuries among the passengers. From some reports in the Press it would appear that the goods train had been crossed over from the up to the down line.

THE death on the 9th inst. is announced, at the age of seventy-five, of Mr. T. M. Williams, C.B., who from 1901, through the war period, to November, 1920, was the docks and marine manager of the London and South-Western Railway. Mr. Williams went to Southampton from the position of dock master at Grimsby, where, no doubt, he had attracted the attention of Sir Charles Scotter, who, before going to the London and South-Western, was the goods manager of the Manchester, Sheffield and Lincolnshire line, whose biggest port was Grimsby.

THE *Great Western Railway Magazine* states that in March, 1928, a gang trolley and ganger's inspection car, propelled by petrol engines, were introduced as an experiment between Cirencester (Watermoor) and Rushey Platt Junction, the ganger's length being extended to 13¼ miles. This experiment has been successful in effecting a saving of time occupied in travelling, and the trolley has proved capable of hauling a trailer conveying a considerable quantity of materials and tools. Arrangements are in hand for the introduction of motor trolleys on other single lines.

A REPORT issued by the Dominion Department of the Interior states that rails have been laid on the Hudson Bay Railway to within 48 miles of its objective at Fort Churchill. At that point active work has been going forward preliminary to port development, employing 349 men engaged in the construction of temporary docks and preparations for permanent construction. So far a total of 3,458,950 dollars has been expended on harbour work at Fort Churchill, and the total expenditure on the Hudson Bay Railway amounts to 23,386,248 dollars. The cost of the railway, exclusive of ocean termini, when completed is estimated at 28,500,000 dollars.

ON steeply rising gradients it is necessary, in order to intercept any wagons that may break away and run back, to provide what are known as catch points. These normally lie open to derail, and are closed by each wheel of a train going up the gradient, being again reopened by a spring. When single-line working is in operation, because of an obstruction and these points have to be passed over in a facing direction by trains, they have to be closed and firmly spiked. Singular to relate, twice within less than a fortnight passenger trains have been derailed when passing over such points in a facing direction. The first was the Flushing continental boat train at Wrabness on Tuesday, January 29th, and the second a passenger train near Stoke-on-Trent on Sunday, February 3rd.

THE report presented to the annual meeting of the Institution of Railway Signal Engineers on February 13th showed that there was a net increase of nineteen members, and that there are now 513 home and 218 overseas members. A couple of years or so ago the scope of the Institution was enlarged so as to include others that were interested in signalling, but who were not actually engaged in signal and telegraph engineering. A possible sequel to that may be found in the intimation in the report that the Council had had to decline applications from a number of engineers and others who do not possess the necessary qualifications for admission. The new President, Mr. R. G. Berry, in his address, urged that the members should provide themselves with suitable Institution premises.

ALTHOUGH the driver of the train concerned in the Charfield disaster of October 13th last was discharged on the police proceedings, it was necessary for him to stand his trial at the Gloucester Assizes in that he was also indicted on the coroner's warrant. No evidence was, however, offered when the case came before Mr. Justice Roche on February 1st, and the man was discharged. On the previous Tuesday, the coroner, with a jury, had been engaged in the very unusual course of holding an inquest without a body. It related to a man who was journeying from Derby to Milverton, and who was believed to have been on the train, but his body was not found. The jury were satisfied that the man was in the train, and that he was accidentally killed. We would add that the proceedings were taken under the Coroners (Amendment) Act of 1926.

THE Canadian Pacific Railway has given an order to the Montreal Locomotive Company for the construction of twenty large oil-burning engines. The engines will be of the 2–10–4 type, the drivers being 63in. in diameter. The oil-fired boiler is to be constructed wholly of nickel steel and to withstand 280 lb. boiler pressure. All forgings are to be of a new composition low-carbon nickel steel. Each engine and tender will measure overall 97ft. in length, will weigh 725,000 lb., and will be capable of developing over 4200 horse-power. The cylinders are 26½in. in diameter and the stroke 32in. These new engines were designed by the Motive Power Department of the Canadian Pacific Railway and will be of entirely Canadian construction. They will be used for the transportation of goods and passenger trains through the Rocky Mountains.

Notes and Memoranda.

COMMENTING on the explosion of a 6in. steam valve, which was caused by water hammer, the Engineer Surveyor-in-Chief, Board of Trade, remarks that it is interesting to note that, in this explosion, the cast steel chest or cover did not fracture as is usual in cases of water hammer, but all the bolts, though of a substantial size and good material, were broken.

ACCORDING to the *South African Mining and Engineering Journal* experiments have been carried out at a Far East Rand mine in equipping tube mills with Michell bearings. The tests have extended over eighteen months with satisfactory results. The outstanding advantage of the application to a tube mill is that the expensive renewal of the cast ends, necessitated by wear of the trunnion journals promises to be greatly postponed, if not practically obviated, while the attention required during operation is reduced to a minimum.

THE President of the Newark Steel Drum Company, one of the largest American firms dealing in second-hand steel drums, recently discussed the advantages of the more careful handling of these containers. He pointed out that denting, which is difficult to repair, can be largely obviated by unloading the drums from the lorry or railway wagon, on to a bag filled with sawdust. Internal rusting is largely due to carelessness in replacing the bungs, or in neglecting to replace them immediately after use. Wherever possible drums should be stored on their sides to prevent the accumulation of water. When drums must be stored on their heads the bung should be at the bottom. It is further advisable to store drums on pieces of old planks to keep them an inch or two off the ground, and dry underneath. Mr. Colville finally explained that the embossing of a drum with the previous owner's name, or trade mark, greatly reduces its value on the second-hand market.

A REPORT in the *Deutsche Bergwerks Zeitung* states that at a meeting of the Coal Investigation Institute recently held at Mulheim-Ruhr, a paper was read on the "Electrical Transformation of Methane or Coking-kiln Gas into Acetylene." In contrast with the former high-pressure syntheses, that result in the formation of petrol and ammonia, a quite new method, which, it is anticipated, will very soon be exploited industrially, is adopted. As catalysers are not used in the process, a previous purification of the coking-kiln gas is not necessary. The essential part of the process consists in subjecting the gas, at a certain pressure, to electric discharges. In that way it is said to be possible to transform the gas into acetylene with hardly any residue, though hydrocyanic acid appears as a by-product. The statement is made that it already seems that it will be cheaper to generate acetylene from coking-kiln gas by this method, than, as hitherto, from calcium carbide.

IN a short article communicated by the director of the Franklin Institute, to the United States Bureau of Standards, it is stated that as much as 200,000 gallons of waste crank-case oil could be collected annually in the district of Columbia. In this connection it is pointed out that the public should be quick to realise the importance attaching to the exclusion of this waste from the public sewers as well as to appreciate the advantage to be gained from its free and regular removal, especially the latter, as it costs the operator some 2 cents to 3 cents per gallon to have it removed when deposited with silt in garage intercepting traps. A decided improvement of the condition of the interior of public sewers may confidently be expected to result from the adoption of these measures, the danger from fires and explosions in sewers minimised, thousands of gallons of oil which has heretofore been a source of danger and expense conserved for reuse and a commercial enterprise of appreciable moment encouraged and developed.

IN connection with the explosion of a steam wagon boiler near Bradford, which resulted in the death of the driver, the Engineer Surveyor-in-Chief, Board of Trade, says that steam wagons are a source of considerable danger to the attendants and the general public if they are allowed to remain in service with the boilers in a defective condition. Suitable arrangements should be made for the boilers to be regularly inspected by competent persons, who should always regard with suspicion fire-box stays which are inaccessible for visual examination. The ordinary method of hammer sounding the ends of fire-box stays may reveal broken ones, but gives no indication as to whether the stays are wasted. It was considered necessary in April, 1927, to renew a large number of stays in the fire-box of the boiler referred to in the report, but no stays were renewed in the left-hand side of the fire-box, and apparently the precaution of removing a few of the stays in that part to ascertain their actual condition was not taken, although it might reasonably have been presumed that the cause of wastage on one side of the fire-box was likely to exist on the other.

THE neon tubes which are now so familiar to the public in various script sign advertisements have found a useful application in replacing white lights for lighthouses serving air routes. In a new light at Lympne, states *Nature*, sixteen tubes 20ft. long are employed in the form of a vertical truncated cone. The light is said to have a candle-power of 6000 and to be visible in clear weather for 45 miles. The neon spectrum gives a number of lines lying for the most part towards the red end of the spectrum, the yellow line 5853 A. being specially prominent. Thus the normal colour of the tube is red orange, unless much argon or mercury vapour are also present. It is therefore possible to obtain a radiation which is comparatively little subject to atmospheric scattering (the intensity of scattering is inversely proportional to the fourth power of the wave-length) while yet remaining of high visibility. The characteristic colour of the light is a strong recommendation; it would be made somewhat more red owing to scattering when seen through fog, but the change would be small in comparison with that experienced in connection with any white light. Experiments have shown that even when the neon light failed completely to penetrate a layer of fog it made a "large red luminous patch on the top of the fog." Such a light has now been installed at the Lympne aerodrome on the London-Paris air route.

Miscellanea.

THE firm of Newton, Chambers and Co., of Thorncliffe, Sheffield, have just completed one of the largest gas-purifying units ever built in this country. The iron and steel work used in the job weighed nearly 3000 tons, and the plant is able to deal with 10,000,000,000 cubic feet of gas a year.

IN Pietermaritzburg, South Africa, there appears to be some indecision as to whether £20,000 should be expended upon doubling the capacity of the water main supplying the town, or whether the metering of supplies should be adopted as a means of checking the present consumption of water.

IT is stated that the French Ministry of Posts and Telegraphs has lodged a protest against the adoption of 1485 m. as a new wavelength for Eiffel Tower, and has requested the Geneva Union to assist in authorising a return to 2650 m. It has also been suggested that the increased power of the Eiffel Tower transmitter warrants its adoption in Europe for the official broadcasts by the League of Nations.

OUR French contemporary, *Le Moniteur des Travaux Publics*, has published a special Bridge number in connection with the Second International Bridge Congress. Whilst there are many omissions, a large number of notable bridges are illustrated and described, particular attention being paid to the remarkable concrete bridge over the Elorn at Plougastel. An interesting chapter is devoted to the failure of bridges during and after construction.

TEST transmission through the high-power short-wave Kootwijk (Holland) transmitter on behalf of the League of Nations commences on March 12th and will be continued on March 19th and 26th for the U.S.A.; on March 13th, 20th, and 27th for Japan; and on March 14th, 21st and 28th for Australia. The broadcasts for U.S.A. will be between 10 and 11 p.m. G.M.T., those for Japan and Australia towards 2 p.m. G.M.T., or as soon after as the existing public telephony service between Holland and the Dutch East Indies permits.

SPEAKING in Sheffield recently, Mr. J. T. Goodwin, of the Cast Iron Research Association, referred to impending developments of an important character in relation to cast iron. The Association, he said, was on the verge of putting before the country and the world generally most important facts with regard to the future development of cast iron. A series of experiments had aroused the interest of the whole metallurgical world, and it was hoped that an announcement would be made which would show that they were in advance of any country in the world.

THE production of benzol in Austria on a commercial scale, states the *Chemical Trade Journal and Chemical Engineer*, is practically confined to the Municipal Gas-works in Vienna, where about 5000 metric tons are produced annually. Of this quantity it is stated that from 1600 to 1800 tons are consumed within the country, the remainder being exported principally to Germany, Italy and Switzerland. A small amount of benzol is also produced by several other companies, but almost exclusively for their own use. Austrian imports are derived almost entirely from Germany and Czecho-Slovakia.

THE Colombian Government will shortly invite tenders for the improvement of the port of Rio Hacha, one of the four Caribbean ports engaged in international trade. The contract will include the reconstruction of the Customs-house and the supply of a considerable quantity of electrically driven loading and unloading machinery. At present vessels must lie off shore to discharge, sometimes under difficult conditions. Besides being a busy trading centre for North Colombia, Rio Hacha has important trade connections with Curaçao in the Dutch West Indies, from which it receives most of its supplies. Pearl-fishing is also carried on.

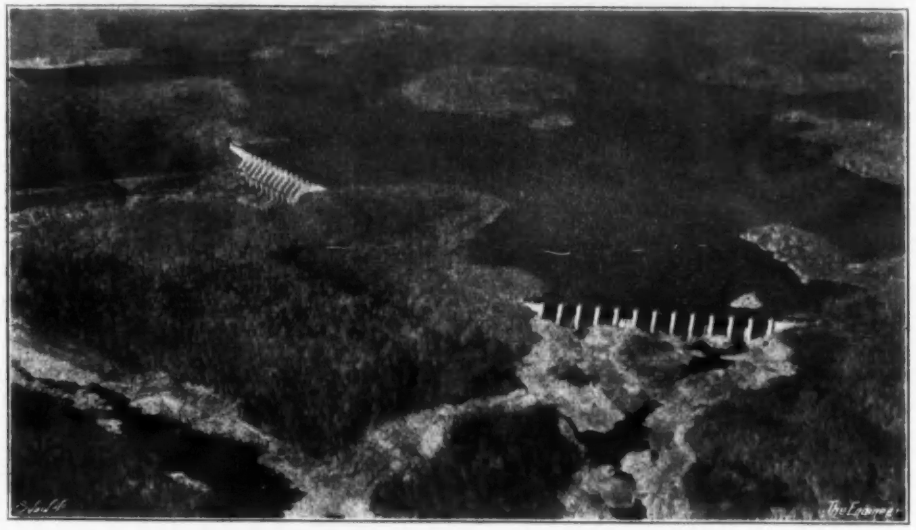
IT is reported that the French State Nitrogen Factory at Toulouse is manufacturing two new fertilisers which are readily being taken up by the French agriculturists. These are ammonium sulphonitrate and ammonium-calcium sulphonitrate. The first, which is made from ammonium sulphate and ammonium nitrate, contains 25·5 per cent. of nitrogen, of which 19 per cent. is in the ammoniacal form and 6·5 per cent. in the nitric form. It is stated to be a white powder which keeps well when protected from water. The second product is a yellow salt made from ammonium nitrate and lime sulphate, and contains 15·5 per cent. of nitrogen and 18 per cent. of lime.

ACCORDING to a statement recently made at Victoria, British Columbia, the Consolidated Mining and Smelting Company of Canada, Ltd., which operates a metallurgical plant at Trail, B.C., proposes shortly to produce steel by an electric-furnace method from the iron waste left in the ores treated for the production of lead, zinc and other metals. This production has been in prospect for the past couple of years, but has been postponed owing to the lack of electric power, which will shortly be obtained as the result of the construction work undertaken last year by the West Kootenay Power and Light Company, Ltd., at Bonnington Falls. The first unit will have a daily capacity of 10 tons of high-grade steel.

OUTBOARD motors were the dominating feature of the New York Motor Boat Show, where 300 boats were displayed. Within two years "outboards" have risen to their present popularity. Instead of confining themselves to racing hulls, the manufacturers have built miniature "runabouts," with leather cushions, wicker seats, remote control in steering and operation, and, in some cases, sedan tops have been added. The small frail types of a year ago have been abandoned because of their inability to maintain even keels in choppy water. The outboard engine manufacturers have co-operated with the hull builders by constructing motors which are silent and develop adequate power even though remaining portable engines. The "runabouts," some of which are of the sedan type, range from 26ft. to 40ft. in length. Internally, the boats are similar to limousines. For the owner who cannot afford the sedan top, open models, seating from eight to twenty persons, have been introduced. These types, like the more expensive vessels, have potential speeds of 30 to 60 miles an hour.

THE ISLE MALIGNE POWER PLANT ON THE SAGUENAY RIVER, QUEBEC

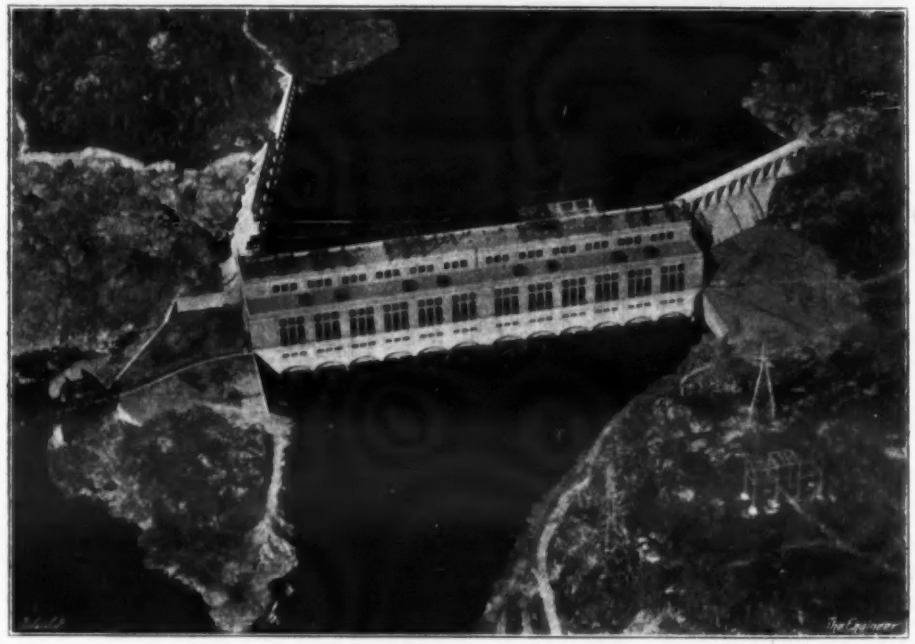
(For description see page 178)



TWO BARRAGES AT UPSTREAM END OF ISLE MALIGNE

GENERAL VIEW: SHOWING POWER-HOUSE, BARRAGES AND BRIDGE

VIEW ALONG BRIDGE AND POWER-HOUSE



DOWNSTREAM VIEW OF POWER-HOUSE

The Engineer

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THE ENGINEER.

FEBRUARY 15, 1929.

The Powers of Joint Electricity Authorities.

ONCE more that much-harrassed legal entity—the electric supply company—has found it necessary to seek redress in the Law Courts against one of the statutory bodies which have been set up for the purpose of securing to the public a cheap and abundant supply of electricity! We refer to the case of the Attorney-General and others *v.* London and Home Counties Joint Electricity Authority, in which Mr. Justice Astbury delivered judgment on February 6th. The facts are comparatively simple. In 1925 the London and Home Counties Joint Electricity Authority was duly constituted under the Electricity Supply Act of 1919, with powers over certain districts, including the County and City of London, the county of Middlesex and parts of Surrey and other adjoining counties. Before the formation of this body, local inquiries were held, and all details had been worked out and agreed on by the authorities concerned. The Authority consists of fifty-three persons representing divers interests. Its financial power is strictly limited, and it has power to levy contributions from a number of electrical companies, including the County of London Electric Supply Company and three other companies—all undertakers within the district. Recently the Joint Authority decided to promote a Bill in Parliament for the purpose, *inter alia*, of enabling it to purchase undertakings which local authorities may purchase; to delegate some of its powers to a joint committee, including persons outside the Authority; and to delegate other powers to local authorities which are not authorised distributors or undertakers. Now the promotion of a Bill in Parliament involves expense. Accordingly, the companies concerned applied by motion to Mr. Justice Astbury for an injunction to restrain the Joint Authority from devoting any of its money to such purpose, and from employing any of its officers or servants in the preparation and promotion of the Bill. After argument, the learned judge granted the injunction. In giving judgment, he pointed out that the transfer to the Joint Authority of the rights of local authorities to purchase had been deliberately withheld. "I have come to the conclusion," he said, "that the deponents have no power to employ their funds for the promotion of the Bill in question or to require the undertakings in their area to pay for the expenses of it. Each clause in the Bill appears to me to be outside the purposes of the scheme. When limitations are imposed by a scheme, it is not," for the purposes of the scheme, "to promote a Bill to get rid of those limitations or to acquire powers for the purchase of undertakings which have been deliberately withheld. Some of the clauses were outside the scope both of the scheme and the Act of 1919." In the result, the County of London Electric Supply Company, Ltd., the Chiswick Electricity Supply Corporation, Ltd., and the Hendon Electric Supply Company, Ltd., have gained their object. Whether they were awarded the costs of the action or not makes little difference; if it had been made the order would not be of much value, inasmuch as the funds in the hands of the Joint Authority available for the discharge of such trifling matters as the costs of an action in the High Court are derived from contributions levied from the plaintiffs and other bodies supplying electricity in the district.

This is not the first time that the Courts have had to interfere to protect the private company. On this occasion it was a Joint Authority; but the conduct of the Electricity Commissioners themselves has been the subject of judicial criticism. In the case of Rex *v.* Electricity Commissioners (1924) (1 K.B. 171), the facts were these. The Commissioners established an electricity district and formulated a scheme providing for the incorporation of a joint electricity authority, which purported to be representative of the authorised undertakers in the district and comprised local authorities and certain electricity companies. The scheme provided that the Joint Authority should at its first meeting appoint two committees—a "local authority" committee and a "company" committee—and assigned to each committee certain districts and certain powers and duties. The Commissioners began to hold a local inquiry with a view to making an order embodying the scheme. Certain of the companies concerned moved the Court for a writ of prohibition, to prevent the inquiry being proceeded with, on the ground that to make such an order was beyond the powers of the Commissioners; and the Court granted a prohibition, notwithstanding that an order, if made, could not come into force unless confirmed by the Minister of Transport and approved by resolutions of the Houses of Parliament. Was ever an industry so much interfered with by the Legislature as that which undertakes the supply of electricity to the public? Ever since 1882 those who have embarked upon this industry have been constantly hampered not only by Parliament, but by the Board of Trade, local authorities, and, more recently, by Electricity Commissioners, Joint Authorities, and, finally, by an Electricity Board, which has jurisdiction over the whole country. The case under review is an illustration of the kind of interference to which a company supplying electricity is subject, and we have mentioned one other case which concerned the Electricity Commissioners. But these cases do not afford any true indication of the amount of interference to which the private company has been subjected. The effect of an Act of Parliament is not to be gauged by the amount of actual litigation which it entails; still less by the number of cases which happen to be reported in the daily Press. It is not always that the company which is enjoined to do something or to refrain from doing something by the Electricity Commissioners or by a body with such a high-sounding title as the "Joint Authority," has the courage to resist. Indeed, the position of an electricity supply company which goes to law with a Joint Authority is parlous indeed, because, having regard to the source from which the Joint Authority derives its revenue, whatever happens, the plaintiff company and other companies whose interests are identical, inevitably pay the costs of both sides! In other words, the private companies, which represent, of course, the consumers, have to pay for the rods with which they are scourged.

In view of the way in which it is subjected to control by Government and Departments, it is amazing how the supply of electricity has flourished in private hands. At the risk of being termed "reactionary," one is inclined to ask the question, Where would the industry have been by now, had those who controlled it been left free? But

matters have gone too far to hope for any measure of reform. There are too many officials with vested interests to warrant any hope that the powers of those for whom they act will be curtailed by Parliament. But the case to which we have drawn attention may at least have the effect of preventing those powers from being exceeded in future.

Boilers for the Mercantile Marine.

THE invasion of the field of marine propulsion by the heavy oil engine is promoting a healthy reaction on the part of those who put their faith in steam. They are realising that if steam is to recover its lost ground, or even to maintain the place still left to it, something has got to be done. There are indeed two separate battles: one the broad contest between coal and oil, and the other the struggle between the steam turbine and the internal combustion engine. If coal can recover its supremacy over oil—and the experiences with pulverised fuel on the "Mercer" and the "Stuart-star" hold out at least the possibility—the battle for steam will be won, and the marine oil engine will revert to an insignificance comparable with that held by oil engines in land power stations. But the survival of steam at sea does not depend upon this possibility alone. Oil may still retain its position as a fuel on account of its many conveniences, but be forced to develop its power through the medium of boilers and steam turbines rather than by direct combustion in the cylinders of an engine. To the academic mind such a process may appear deplorable. But good engineering is a matter of economics rather than academics, and once it can be shown that there will be an overall saving in using oil to make steam and using steam to drive the ship, no arguments of thermodynamics will save the internal combustion engine.

Those who believe that steam will come into its own again at sea are by no means few. They can point to the comparative failure of the oil engine to make any impression on central station practice, where overall cheapness of power production combined with reliability is the one and only aim. Nor can they be answered effectively by the retort that the price of oil prohibits the use of such engines. In the United States, where oil is cheap, the large oil engine for power stations is almost non-existent. Indeed, the cheaper the fuel the greater the inducement to use it for steam raising. At Medicine Hat, in Western Canada, where natural gas of nearly 1000 B.Th.U. per cubic foot was available in unlimited quantities at the cost of a few cents per thousand, it was burned under boilers in the city power station rather than used in gas engines. Presupposing the use of oil fuel at sea for reasons of ease of bunkering and firing, there are two reasons why the oil engine has supplanted steam machinery; firstly, its consumption of fuel is substantially less; and secondly, the absence of boilers increases the space available for cargo. To maintain its position it must retain these advantages, or at any rate a sufficiency of one or both of them. But whether it can do so is still an open question. The efficiency of an oil engine is very high, but, on the other hand, it is practically fixed. A big engine has no appreciable advantage over a small one in the matter of fuel consumption per horse-power, and the difference between the economy of the best and the worst of reputable modern engines is very slight. Nor does there seem any prospect of substantial improvement. More power may be got out of a cylinder of given dimensions by using a two-stroke cycle, making the engine double-acting, or super-charging, but all these variations of the original type have already been brought into practice and their limitations are known. With steam, on the other hand, the position is very different. Sir Charles Parsons and Mr. Birger Ljungstrom have both maintained that the construction of a steam plant which would produce a shaft horse-power for no more fuel consumption than a Diesel engine was within the bounds of practicability. Indeed, the performance of the large Parsons turbine at Chicago proves the claim to be justified. But before we can hope to have efficiencies of this order with steam machinery at sea marine engineers will have to be converted to the use of pressures and temperatures far in advance of those which gave way before the oil engine. The features of modern land practice, so far as they are applicable, must be transferred to shipboard, and the debt which power stations owed to marine experience in the early days may now be repaid with interest. The key to efficiencies which will enable steam plant to hold its own with, or even to dispossess the oil engine at sea, lies almost entirely in the improvement of steam conditions. At the root of this question lies the type of boiler to be used. In a paper entitled "Water-tube *versus* Scotch Boilers," presented to the Liverpool Engineering Society on January 30th, which we summarise elsewhere to-day, Mr. J. Austin said probably all that there is to be said, and that is much, in favour of the old and well-tried Scotch marine boiler. The efficiency of that type of boiler is undoubted, and Mr. Austin's claims that it can beat certain sorts of water-tube boilers are further supported by tests made during the war by the United States Government when deciding on the kind of boiler to be used in "standard" ships. It is a boiler, indeed, which can hardly help being efficient if properly used, for its construction renders air leakage and losses by radiation extremely small. Nevertheless, one would have to go a long way to find one installed in even a small power plant on land. When really high pressures are involved the Scotch boiler is simply out of the question, and it also lends itself very badly to the addition of a superheater. It may be partly on this account that superheated steam has made so little progress at sea. There is not the least difficulty in generating steam in land boilers at any pressure or temperature desired, and it may be pointed out that two of the boilers largely used in power stations for modern steam conditions both first established their reputation in marine practice. Moreover, as was mentioned by Admiral Whayman in the discussion on Mr. Austin's paper, Messrs. Babcock and Wilcox have no less than 5100 boilers installed in 1360 sea-going vessels, so that it is now far too late to object to the suitability of water-tube boilers for marine service. It is not to be expected that any type of water-tube boiler will stand long steaming with bad feed water so well as the Scotch boiler does, but there is no reason why the provision of pure feed water by means of evaporators should not be as much standard practice at sea as on land. The other advantage of the Scotch boiler, and the feature to which it so largely owes its efficiency, is the complete envelopment of the furnace by heat-absorbing surfaces. Refractory material is entirely absent, the radiant heat from the burning fuel and the luminous flames passing everywhere directly and most efficiently into the water-cooled metal. All arguments as to the necessity for brickwork or refractories in a furnace are refuted by the excellent combustion obtainable in Lancashire, Scotch and locomotive boilers where the fires are surrounded on all sides by bare cold metal. The ordinary water-tube boilers are all more or less defective in this respect, though their makers are gradually admitting the principle to be correct by the increasing use of water walls in furnaces. The marine engineer may reasonably ask that any water-tube boiler designed for him shall have the smallest combustion chamber compatible with efficiency, and the only way to get it is to make every part of its walls a heat-absorbing surface. This has been done in the Wood steam generator, the furnace of which is completely enclosed by walls, roof and floor of bare tubes.

If steam engineers are to recover the place they have lost in marine engineering, they must adopt every development of land practice, without sheltering themselves behind any belief that "it is unsuitable for conditions at sea" unless it can definitely be shown to be inapplicable. There is some consolation to be derived from the fact that the highest pressures now used at sea are in British boats and that marine engineers have been actually in advance of power station engineers in this country in adopting pressures above 300 lb. or 400 lb. per square inch. The pressures, temperatures and designs of a dead past ought to be buried with it and the possibilities afforded by our greater knowledge and better materials exploited with all the courage which the present situation demands.

Obituary.

JAMES RICHARDSON.

ALL engineers connected with the development of the marine oil engine will have learned with great regret of the death of Mr. James Richardson at Glasgow on Wednesday, February 6th.

James Richardson was born in London in 1887 and was therefore only in his forty-second year at the time of his death. He was the only son of the late Sir Alexander Richardson, and was educated at Dulwich College and the Central Technical College. After leaving the University he joined the staff of the British Corporation for the Survey and Registration of Shipping, and for a little over a year gained experience in inspection work and in the formulation of new rules applying to internal combustion marine engines. This particular branch of marine engineering attracted him keenly and later he made it peculiarly his own.

In 1911 he secured a position with Scott's Shipbuilding and Engineering Company, Ltd., at Greenock, under Mr. James Brown, and became assistant engineering manager, and he was responsible for the design of propelling machinery for both tankers and submarines. It was about 1912 that the British Admiralty decided to employ internal combustion engines of the two-stroke single-acting type in submarines, all previous engines having been of the four-stroke type. The Italian "Fiat" design was chosen, and the first two engines were built at the Turin works of Fiat San Giorgio, where in the summer of 1913 Mr. Richardson went to supervise the bench trials. Four similar engines of this type with an output of 300 B.H.P. were subsequently built at Greenock by Messrs. Scott's.

On August 1st, 1916, James Richardson was appointed by Lord Invernairn to be the Chief Technical Assistant to the Engineering Manager, Engineer-Captain W. Onyon, R.N., at the Dalmuir Shipyard and Engine Works of William Beardmore and Co., Ltd. His duties were at first confined principally to increasing the production in the marine engine shops. After the war Mr. Richardson was sent to the Continent to find a suitable marine oil engine for manufacture at Dalmuir. He spent some time in various centres and finally recommended his firm to take out a licence for the "Tosi" director valve type of four-stroke engine. This was done, and the Beardmore-Tosi engine was subsequently developed in collaboration with the technical staff of Tosi Brothers.

When in 1920 his father and Sir Archibald Hurd decided to enlarge the scope of "Brassey's Annual," James Richardson was entrusted with the marine engineering articles, which he continued to contribute with conspicuous success. After the death of his father he continued the production of "Brassey's Naval and Shipping Annual" according to the programme which his father had laid down, and shortly before the end of last year he completed the volume which is about to be published. His later work at Dalmuir brought him into contact with Dr. Bauer, with whom he collaborated in the design of the Beardmore-Tosi double-acting oil engine and the Beardmore-Vulcan clutch. His early death, which followed an operation for appendicitis, is a severe loss to his wife, children, and the firm he has served for so long, and will be keenly felt in marine engineering circles, both at home and abroad.

ARTHUR HINTON ALLEN.

WE greatly regret to have to record the death of Mr. A. H. Allen, the editor of our contemporary, the *Electrical Review*. He was taken ill with influenza ten days ago and died on the morning of February 13th at his home at East Dulwich-grove. He was born in August, 1872, and was therefore fifty-seven years of age. After serving his apprenticeship with Norman and Son, electrical engineers, of Glasgow, he subsequently became assistant to the late Professor Andrew Jamieson. Between the years 1890–1894 he was with Messrs. J. H. Holmes and Co., of Newcastle-on-Tyne, whilst between the years 1894 and 1899 he held the post of demonstrator and lecturer on electrical design at the Central Technical College, London. He joined the *Electrical Review* as technical sub-editor in 1899, and became technical editor and a director of the journal at the death of Mr. T. E. Gatehouse, who was editor-in-chief up to the year 1921.

Mr. Allen was known to a very wide circle of electrical engineers and was universally and deservedly popular. He brought to the *Electrical Review* both technical and scientific knowledge of the electrical engineering industry, and under his editorship the progress of the paper continued on the lines which his predecessor had followed with such marked success.

Institution of Mechanical Engineers.

NORTH-WESTERN BRANCH.

AT A MEETING of the North-Western Branch of the Institution of Mechanical Engineers, held at the Engineers' Club, Albert-square, Manchester, on Thursday, January 31st, the paper by Mr. H. L. Guy entitled "Modern Development in Steam Turbine Practice," the reprinting of which was completed in our last issue, was read and discussed. Professor Dempster Smith, Vice-Chairman, who occupied the chair for this meeting, remarked that he thought that something should be done to facilitate what Mr. Guy apparently had at heart, *i.e.*, an investigation into the behaviour of ferrous metals under stress at high temperatures. They had heard from Mr. Guy that the Department of Scientific and Industrial Research had offered to come forward with £1500 towards the £3000 per annum required to carry out experiments. Since that matter was to the advantage not only of the turbine, boilermakers and high-pressure steam plant manufacturers, but also to the user and to steel maker, it was reasonable to expect that they should assist in financing that research. For example, the

Institution might be approached with a view to contributing to the research, and thereby continue to take an active interest in the study of problems which were of supreme interest to its members.

Mr. W. H. Child, in opening the discussion, said that he was particularly interested in the subject, and had had many of the figures Mr. Guy had shown on the screen that evening at his finger ends for the last twelve months, for a good reason. He represented a company for which Mr. Guy was making a plant. As an engineer of long experience, and knowing that there was such a thing as creep, he had particularly wanted to know what other people were doing. To handle that subject and to appreciate it in its proper light, one had to understand its proper relative value. In the United States he had had the privilege of being the first Englishman to see a 160,000-kW set with a single shaft, two cylinders, and one alternator running on a test bed. In general, the paper was absolutely right. The figures were authentic. The Americans who worked at 1200 lb. pressure and 750 deg. of heat were undoubtedly of the same opinion. But Mr. Guy's company was even bolder; the sets it was testing were for 850 deg. Fah.—higher than anything attempted in America.

Dr. Petrie said that the paper was crammed full of valuable suggestions, important statements of fact, and had a few—very few—points with which he ventured to differ. The plea for standardisation of steam pressures, as supported by the smallness of the gain to be obtained from small changes in initial pressure, was one which he felt sure would have all the support of all manufacturers of power plant. The sizes suggested by Mr. Guy were very reasonable, and purchasers ought to realise that it would benefit them to encourage some such standard, because in view of the enlarged experience that would then become valuable, as he—Dr. Petrie—saw it, Mr. Guy's suggestion amounted to a development of a standard pressure for a standard size unit. The paper touched on the use of resuperheaters to make use of high-temperature steam and the resultant gains in economy, and to avoid the necessity of subjecting the turbine to steam at excessive temperatures. There were two points which had passed through his mind in that connection. The first was the desirability of resuperheating at all, when other means of regeneration were available. He took it that the idea of employing such a method as resuperheat had arisen from long gazing at the well-known Mollier diagram, which plotted the total heat in the steam against entropy. Owing to the relative slopes of the various curves on that diagram, it would be visible to all that the higher the chosen initial pressure the wetter the steam would be at exhaust for any given vacuum. It was generally agreed that the stages of the turbine using superheater steam were more efficient than those which used wet steam, though it was difficult to reconcile the overall efficiency predicted for high-pressure turbines if the wet portion lost its efficiency, as had been stated in some quarters. Resuperheating was intended to increase the number of turbine stages lying in the superheater region, and so save the possible loss of efficiency in the wet region. The other point was one which was a statement made in connection with the resuperheating of the type "B," which, it would be remembered, the author had said would be designed only on the very doubtful assumption that the boiler plant, valves and pipe lines could be successfully operated at considerably higher steam temperatures than steam turbines could be constructed to employ. That was a statement with which he heartily concurred. There seemed to be no doubt that the turbine builders in this country would be ready and willing to produce a steam turbine capable of dealing successfully with steam temperatures of the order of 850 deg. Fah. on the first row of nozzles. Unfortunately, it appeared that the safe maximum steam temperature at which the tubes of the superheater would function was 750 deg. Fah. In the short time that he had been in direct contact with that class of work he had come across seven cases of failure of superheater tubes at and above 800 deg. Fah. He was inclined to think that high temperatures, when they could be obtained with moderate pressures, say, not greater than 600 lb., were more likely to prove satisfactory than burdening the whole plant on the boiler side of the stop valve with excessive pressures.

Mr. R. W. Bailey said that it might appear at first sight that one was plunged into the dark by going to higher temperatures. American engineers had avoided many of the difficulties by raising steam pressures and not altering the temperatures, so that they were dealing with the same physical properties of metals. When it came to altering temperatures, changes which brought about a reduction in the strength of the materials occurred. The question of the attack of media on the metal came into play, because of the influence of temperature as an accelerating factor. Another matter was the possible effect of temperature upon the structure of the metal itself. All those matters had been investigated and a certain amount of experimental data had been obtained, but as one who had had something to do with the subject, he felt that there was such a state of ignorance at the present time that further research was absolutely essential. The data Mr. Guy had given, which showed how the strength fell off as the temperature increased and how one could compensate for increase in temperature by lowering the pressure were based on a fair amount of experimental evidence, as had been shown in the tables. That, however, was not enough. They had to find out a good deal more about the influence of high temperatures upon steels, and only co-ordinated research could produce the information quickly. He endorsed the remarks of Mr. Guy in urging the need for assistance in that connection.

Mr. Lunn said that he had been pleased to hear a previous speaker say that there were private companies in England which were willing, in conjunction with the manufacturers, to carry out experimental work in the use of these high temperatures. Municipalities and power companies in the past had done most of the pioneer work in that direction, and he was very thankful that private companies were now preparing to play their part. The problem of erosion of the low-pressure blading was familiar to all those who had operating experience of steam turbines. On that point alone, whether there was any efficiency to be gained or not, Mr. Guy was to be congratulated on bringing to the notice of engineers the possibility of any scheme that would overcome the difficulty which the problem presented. With regard to the phenomenon of creep, that had been experienced even when using very low temperatures of superheat, and therefore it was difficult to visualise the possibilities as a result of employing steam temperatures of from 850–900 deg. Fah.

Mr. H. Midgley said that Mr. Guy had put forward a very lucid statement as to the comparative merits of high pressures and high temperatures, and made it quite clear that the percentage increase in temperature required for a given improvement in efficiency was much less than the percentage increase in pressure required for the same improvement. However, a difficulty arose with regard to the raising of temperatures, and that was that if special steels were necessary there might be considerable danger of mild steel being accidentally used instead of special steel for any replace parts required in a hurry, unless the various special qualities were standardised and stocked in quantity. He would like to ask Mr. Guy at what temperature it was necessary to depart from the use of ordinary mild steel.

Mr. J. C. Oakden remarked that several people had touched on the alteration of wetness in the exhaust owing to the higher pressures. One knew, of course, that an increase in the wetness would have an adverse effect on the life of the turbine, and one might imagine that the life of the turbine would be decreased in reverse ratio to the amount of wetness. Could Mr. Guy give them any information about the increased wetness on the life of the turbine?

Mr. J. E. Shakeshaft said that Mr. Guy, in his paper, advocated the development of high temperatures for turbine work, chiefly on the basis of getting rid of the wetness in the exhaust, and on that account of the deterioration of the blading which apparently fixed the limit to the life of the machine. He had had some experience in that matter, and it seemed to him that the use of high temperatures in turbine work was going to introduce a difficulty other than that of wetness. He referred to the little-known question of blade vibration. It was commonly known in the turbine design world that there had been a great deal of trouble with blade failures, owing to vibration, and that was on account of the super-imposition of vibrations on highly stressed material. The use of high temperatures led to a reduction in the allowable stress on material. In that case what was going to happen to blades when steam was used at temperatures above those now in use?

Mr. R. D. Lauder said that a point he had noticed in the paper was the development of auxiliaries. Judging by the diagrams which Mr. Guy had shown of the feed heaters, it seemed to him that it was a case of how many feed heaters and evaporators, and that the turbine itself was only a side-line. In connection with the temperature of 800 deg. mentioned by Dr. Petrie with regard to the failures of superheater tubes, he believed it was a fact that Mr. Guy was at the present time designing a plant which was going to use 850 deg. Fah.

Mr. Hetherington asked if Mr. Guy had any experience with the erosive effect of steam at high velocities and temperatures.

Mr. M. Dundas remarked that, as a central station engineer, he had been struck with the comparatively small gain they were going to get from those very high pressures and temperatures. Against that was the possibility of failure. Mr. Guy had emphasised the question of creep; his own experience with moderate pressures to-day had showed him that that was going to be a very much more difficult job to overcome in the future. With regard to the question of superheat, if they were going to have 850 deg. at the turbine stop valve, what temperature were they likely to get in the superheater? A previous speaker had mentioned the fact that with very large units it was a difficult and costly matter to get such a unit down for repair. A big boiler took time to cool down. With boilers of the capacity being put down now that represented very serious loss to the station output.

Mr. Guy, in replying to the discussion, said that many of the points which had been raised concerned things which had not yet been tried out. He would like to give his answer to some such points in about five years' time. Mr. Child had raised one or two rather important points. First, there was the question of the exchange of information, which flowed far more easily in America than in this country. Surely the Institution of Mechanical Engineers was a fitting place where the exchange of such information and experience could be encouraged between manufacturer and operator. Mr. Child had also referred to the very important fact that it was far easier to get people in America to lay down an experimental plant than it was in this country. He—Mr. Guy—had ventured to suggest last summer at the Civil Engineers' Conference that now that so much power plant was controlled by a centralised public authority it would be in the national interest that of the plant laid down, perhaps 80 per cent. or 90 per cent. of it should be on well-founded standardised lines, and that the remainder should be purely experimental. He thanked Dr. Petrie for his contribution to the discussion. With regard to the failure of superheater tubes at 800 deg., which he had mentioned, Mr. Guy said that he would point out that at one of the first meetings of the High Temperature Research Committee it had had before it the reports of failures of numbers of superheaters in the country. These failures had been as frequent with temperatures of 500 deg. as with temperatures of 700 deg. Mr. Lunn might have told them that, on the curves and statistics he had showed the peaks had represented pioneer work. One of the most prominent peaks was that which the Manchester Corporation had set up when it had established the fact that it was possible to work successfully at 350 lb. pressure and 700 deg. temperature.

He could not add anything to what Mr. Bailey had said, except to remind him that on the occasion of the discussion of his paper on economic pressure it had been he—Mr. Bailey—who had insisted that he should write one dealing with high temperatures.

Mr. Midgley had raised some very real points. It was true that steam re-heaters would be very uncomfortable things to accommodate in power stations. Further, they would be uncomfortable to design. The design of a successful steam re-heater was a very difficult constructional problem that would have to be solved in the future. Mr. Midgley had also asked what limiting temperature one could go to with mild steel. That was one of those questions which he would have to defer for about five years.

In reply to Mr. Oakden, the question of the wetness in the exhaust had not been reduced to quite so fine a point that one could closely correlate the degree of wetness with the life of blading. They knew that where the wetness had been increased beyond the limits mentioned deterioration had been unduly rapid.

Mr. J. E. Shakeshaft had referred to a point which had been dealt with in the paper. It was important that as temperatures were increased the coefficient of elasticity with Young's modulus of steel decreased with temperature. That had many important results: (1) the elastic deflections of structural parts would be about 18 per cent. greater at 900 deg. than they would be at normal temperatures; and (2) the critical speed of any part was affected by that decrease in elasticity. It was customary to design turbine shafts so that their critical speed was at least 25 per cent. If that were desired when the temperature was 900 deg. the critical speed would have to be 36 per cent. above the running speed at 60 deg.

Mr. Hetherington had inquired whether if the steam pressure were increased the amount of erosion had increased. The answer to that was, in general, in the negative. The expansion was being divided up into an increased number of turbine cylinders, so that the velocities of the steam had been materially reduced. With regard to the erosive resistance of nickel steel and stainless steel, he was not prepared to say that one was substantially better in all cases than the other.

With regard to the remarks of Mr. Eccles, Mr. Guy said that he thought that it was fairly safe to say that the gains which had been predicted would accompany increases of temperature had always matured. Gains which were expected from increased pressure sometimes matured.

ROAD MOTOR TRANSPORT IN SOUTH AFRICA.

THE route miles operated by the road motor vehicles of the South African Railways have increased since November, 1927, from 6119 to 8667 and 2016 additional route miles have been authorised. Farmers have expressed their high appreciation of regular facilities, but for which many of them could not produce light perishable goods on account of the time occupied on the journey between the farms and the railway. The road motor services convey about 100,000 passengers a month, 10,000 tons of goods traffic, and from 30,000 to 70,000 gallons of cream according to the season of the year. The scope of the service is still being extended. At first the largest type of vehicle employed had a net load capacity of about 2000 lb. To-day there are six-wheel vehicles with a net loading capacity of 12,000 lb. to 16,000 lb. and double the loading space of the earlier type. It is now possible to convey fairly bulky consignments, such as wool, skins, hides, machinery and agricultural implements. Since April of last year the number of road motor vehicles in service has increased from 140 to 300, and many of the larger type are used. One of the latest has separate compartments for Europeans and natives, with a goods compartment at the back. Several services have from ten to fifteen vehicles running daily.

Industrial Heating by Gas.

WE recently had an opportunity of inspecting at work several industrial heating installations, which have been supplied by Premix Gas Plants, Ltd., of York Mansion, Petty France, Westminster. Of these plants two were working on producer gas, while one was using town's gas, but they all embody several similar characteristics.

As is suggested by the name of the firm, the general principle underlying the system is to mix the gas, and some of the air necessary for combustion, by a special apparatus, before they are delivered to the distributing mains and only supply a comparatively small extra amount of air at the burners. The reason for this process is, of course, the difference in the specific gravity of the gas and air, which would otherwise tend to make them stratify in the pipes and produce uneven burning. By thoroughly churning up the gas and air, a uniform mixture which does not tend to separate is obtained, so that good flames and high temperatures can be had without it being necessary to have high velocities at the burners.

The incorporation of the mixture is effected in the machine shown in Fig. 1, which also maintains a constant quality of mixture and pressure regardless of the working conditions. As will be seen from the sectional drawing, it comprises a simple rotary blower or compressor, without valves. It is fitted with sliding blades of compressed fibre, and we are told that these blades will generally run about two years, naturally depending upon the hours of working, before they need renewal. The shaft runs in ball bearings, which require very little attention, and as the machine does not run at a very high speed, its maintenance is a simple matter.

It will be noticed that between the suction and delivery branches of the mixer there is a by-pass of full bore reaching across the top of the barrel. In this by-pass there is a piston valve A connected with a leather diaphragm B. The underside of this diaphragm is subject to the outlet pressure, through a pipe connection and a fine hole, which damps out pulsations, and the pressure is balanced by weights on the top of the valve. The arrangement is such, that if the delivery pressure rises, which happens if the demand for gas falls off, the valve in the by-pass opens and the gas is returned to the suction side of the mixer. The proportions of the valve are such that it maintains a constant pressure at the delivery at any output from no load to full load. A pilot burner is arranged on the delivery branch, and is kept burning to show that the proper working conditions are maintained.

The quality and quantity of the gas and air mixture is maintained constant by automatic valves at the inlets. The double-beat valve C so controls the gas inlet that the gas in the box D is always at exactly atmospheric pressure, regardless of the pressure in the supply mains. The valve, it will be seen, is operated by a leather diaphragm, the pressure on which acts against a little weight on a rocking lever connected with the valve spindle. Fine adjustment of the balance can be effected by placing washers on the top of the diaphragm. The result of this arrangement is that the gas, from the box D, and the air from the screened inlet E, both arrive at the twin inlets F and G at the same pressure. Above these inlets, and controlling their connection with the suction side of the mixer, there are two slide valves H and J, which work transversely to one another. The lower valve H is of grid-like form, and can be manipluated by hand across the ports from the inlets F and G, so as to pass any desired proportion of gas and air according to the immediate requirements of the apparatus being served. The upper valve J is a simple slide, and serves to open or close the slots in the lower grid valve, according to the demand of the gas-consuming appliances. To this end it is connected with the diaphragm K, which is spring-controlled and responds to the ultimate suction of the mixer.

To put it briefly, the devices C, E and H determine the quality of the mixture supplied by the machine, the valve J determines the quantity of mixture which may pass through the machine, and the valve A settles the pressure at which it is delivered. One of the essential ideas of the whole scheme is that the pressure and quality of the mixture

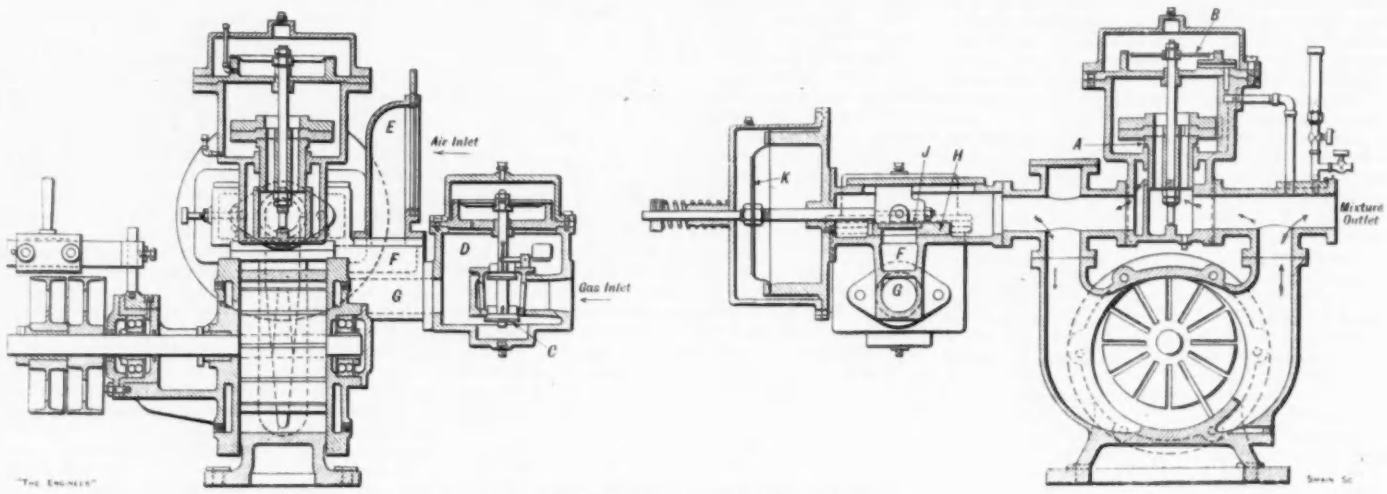


FIG. 1—THE "PREMIX" GAS AND AIR MIXER

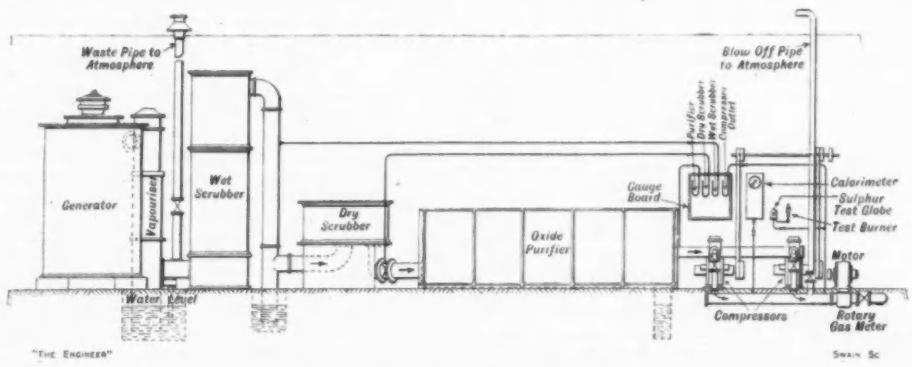


FIG. 2—GAS HEATING PLANT AT MESSRS. KENT'S WORKS

produced should be constant, so that the attendants on the individual burners need exercise no special vigilance.

As concerns the ultimate destination of the mixed gas, it is hardly necessary to enlarge, as it may be used for such a variety of purposes, and incidentally may be derived from a wide field of sources. But it may be of interest to give a brief account of the impressions gained on our recent tour.

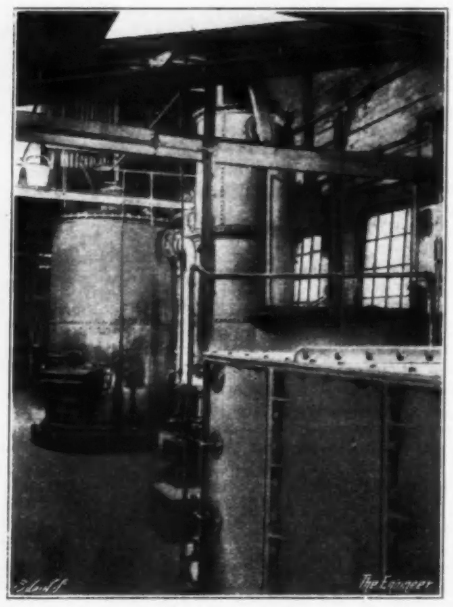


FIG. 3—GAS PRODUCER AND PURIFYING PLANT

Taking the several installations which we visited in turn at the works of G. Kent and Co., of Luton, there is a plant, illustrated in Figs. 2, 3, and 4, which comprises a National gas producer and a gas-cleaning plant, including an oxide purifier, working in conjunction with two of the compressors we have just described. In this connection it is noteworthy that some of the steam necessary for gasification of the fuel is supplied by a small, separate coke-fired boiler, as that arrangement has been found most convenient in meeting the requirements of light-load running.

This gas-making plant is run in a most methodical manner, as might be expected in a factory largely devoted to the production of meters, and careful records are kept of its performance. It has a nominal full-load rating of 23,000 cubic feet of gas per hour, but is at present working at only about half load, but even in these circumstances a recent four weeks' trial showed the following results:—The actual running time was 310 hours, and during that time 501 cwt. of coal were consumed, while 1849 B.Th.U. of electricity were used for running the plant, and 214,200 gallons of water were used in the scrubbers, vaporiser, &c. The average output of gas was 12,700 cubic feet per hour. Allowing that the cost of the fuel was 42s. 6d. per ton, that the electricity supply cost ¾d. per unit, that water was supplied at 6d. per 1000 gallons and for labour 1·7d. was paid per hour for the running of the plant, the total hourly cost of those 12,700 cubic feet of gas works out at 6·10d., and the calorific value of the undiluted gas supplied is of the order of 135 to 140 B.Th.U. per cubic foot.

Subsequent to our inspection of the gas-making plant itself, we made a tour of George Kent's works, where the gas is burned, including the canteen, and we noticed that, although during the period of our visit the works had been shut down for the dinner hour, which obviously meant a material diminution in the demand for gas,

FIG. 4—TWO "PREMIX" INCORPORATORS

the flames at the burners still in commission remained virtually constant. The heat treatment of steel forms an important part of the work carried out in the works, and a large proportion of the gas is used for that purpose. We visited several departments of this kind, and in the hardening shop were informed that as many as 90,000 Morris car parts are frequently treated in one week.

Our next visit was to the Basingstoke works of J. I. Thornycroft and Co., where there are two gas producers of much the same nature, and a third set aside to utilise the scrap coming from the wood-working shops. There, the process is very similar to that which we have just described, except that it is not considered necessary to incorporate an oxide purifier to eliminate sulphur from the gas. We noticed, however, that this producer gas is being used extensively for brazing and similar purposes, and for such services a special blow-pipe has been devised.

With a comparatively low calorific gas, such as that provided by a "producer," there is, of course, a tendency for the flame to be blown away from the mouth of the blow-pipe, if the gas pressure is much above that of the atmosphere, with the consequence that it is extinguished. This trouble has, however, been overcome by providing

several by-pass passages round the burner, which, by their constriction, reduce the pressure of the gas at their outlets, and give a steady flame which ensures the ignition of the main body of gas.

At the Basingstoke works the gas is also used in an extensive set of hardening and heat treating furnaces, and in these cases we were impressed by the fact that although very high temperatures were being maintained, there was a notable evenness of temperature throughout the furnaces.

In the Vickers works at Weybridge town's gas is used on the same principle, but, in view of its greater calorific value, it naturally requires a greater admixture of primary air—that is to say, air added at the time of incorporation at the mechanical mixer. The adjustment is, however, easily made, by means of the slide valve H—see Fig. 1—without it being necessary to depart from the standard arrangement of the mixer. It is, in fact, in this direction that one of the great merits of the apparatus resides, as it can be provided with alternative connections with a producer and with the town's mains, so that in the event of either supply failing the other source can be drawn upon without there being any interference with the continuity of working. Incidentally, the use of the mixer compressor obviates the necessity for a gas holder, as the suction through the producer is dependent only upon the demand for gas, the pressure is maintained constant and, within reasonable limits, the producer can be relied upon to respond quickly to variations in the load.

Lloyd's Register: Annual Summary

LLOYD'S Register Annual Summary of the Mercantile Shipbuilding of the World for the year 1928, was recently published, and, following our usual custom, we give below a *précis* of its contents. It will be remembered that this summary does not include warships, and that it takes into account only merchant vessels of 100 tons *gross* and upwards, that were *launched* in 1928, whether they were completed during the year or are still under construction. Sailing vessels fitted with auxiliary power are included with steamers or motor ships, according to type of engine. Returns are not available as regards Germany and Austria-Hungary for the war period (1914–18), or as regards Germany for 1919 and 1920.

GREAT BRITAIN AND IRELAND.

Particulars of Total Output.—During the year 1928 there were launched in Great Britain and Ireland 420 merchant vessels of 1,445,920 tons (viz., 330 steamers of 1,012,774 tons, 76 motorships of 427,916 tons, and 14 barges of 5230 tons). With the exception of a composite yacht fitted with oil engines, all these vessels were built of steel; and no sailing vessel was launched during the year. The output for 1928 was 220,047 tons higher than than for the year 1927. The present total represents 53·6 per cent. of the world's output for 1928, which is exactly the same percentage as for 1927, as compared with 38·2 per cent. in 1926; 49·5 per cent. in 1925; 64·1 per cent. in 1924; and 58 per cent. in 1913.

Nationality of Vessels Launched.—Of the tonnage launched during the year, 1,153,636 tons are for registration in Great Britain and Ireland, and 292,284 tons—20·2 per cent. of the total tonnage—are for owners residing abroad. This percentage compares with 21·8 per cent. in 1927, 14 per cent. in 1926, under 16½ per cent. in 1925, under 15½ per cent. in 1924, and an average of over 22 per cent. for the five pre-war years, 1909–1913. No less than 122,972 tons are intended for registration in the British Dominions overseas.

Size and Type of Vessels.—The returns for 1928 show that 97 vessels of between 5000 and 10,000 tons each and 16 vessels of 10,000 tons and upwards were launched. The largest are the turbine steamers "Duchess of Bedford" (20,123 tons); "Duchess of Richmond" and "Duchess of York" (each of 20,022 tons); the turbo-electric vessel "Viceroy of India" (19,000 tons); and the motorship "Rangitiki" (18,000 tons). Excluding vessels of less than 1000 tons, 51 vessels, of 300,348 tons—24 steamers, of 113,490 tons, and 27 motorships, of 186,858 tons—for the carriage of oil in bulk were launched during 1928. Of them, 41 vessels of about 265,000 tons, were built on the Isherwood system of longitudinal framing. Included in the latter figures are 15 tankers of 90,297 tons, built upon the "Bracketless system," a modification of the Isherwood longitudinal system. The tonnage of steamers fitted for burning oil fuel, launched during the year, amounted to over 310,000 tons. The tanker tonnage, including four vessels of less than 1000 tons each, represented 21 per cent. of the total tonnage of the steamers and motorships launched during 1928. The returns include a number of vessels designed for channel, coasting, fishing—54 vessels—towing, harbour service, and other special purposes. The average tonnage of steamers and motorships launched during the year was 3548 tons. If the vessels of less than 500 tons are excluded, the average is increased to 4656 tons, as compared with 4193 tons in 1927; 4486 tons in 1926; 4439 tons in 1925; 3777 tons in 1924; and 3805 tons in 1923.

Vessels Fitted with Turbines.—Further progress was recorded in the use of steam turbines during 1928, when 15 vessels with a total tonnage of 138,094 tons, which will be fitted with that method of propulsion, were launched. These figures include one vessel, of 19,000 tons, fitted with turbines in conjunction with electric motors; and two vessels, of 7777 tons, which have a combination of steam turbines and reciprocating engines. It may be stated that the four largest vessels launched during the year are fitted with steam turbines.

Vessels Fitted with Internal-combustion Engines.—The tonnage of vessels fitted with internal-combustion engines is steadily increasing in comparison with the total output. The tonnage of such vessels launched during 1919 was 32,936 tons, while during 1926 it amounted to 201,913 tons, and to 355,779 tons during 1927. During the year 1928, 76 motorships of 427,916 tons, were launched, this tonnage equalling 42½ per cent. of the *steam tonnage* launched. The largest motorship launched during the year was the "Rangitiki," of about 18,000 tons, and it may be of interest to note that while the average gross tonnage of the steamers of 500 tons gross and upwards launched during 1928 was 4112 tons, the similar average for motorships reached 6732 tons.

Output of Leading Ports.—The Clyde district occupied first place amongst the ship-building centres, showing an output of 571,948 tons. Then followed the Tyne—300,508 tons—the Wear—207,646 tons—the Tees—132,966 tons—Belfast—75,738 tons—and the Mersey—73,197 tons. The largest increase, as compared with 1937, took place on the Clyde, the figures for which were 148,225 tons higher than those for the previous year. The increase on the Wear amounted to 44,876 tons; on the Mersey to 36,561 tons; and on the Tyne to 26,452 tons; the figures for Belfast showed a decrease of 31,443 tons.

Progress of Shipbuilding During the Year.—As regards the movement of the shipbuilding industry during the course of 1928, Lloyd's Register quarterly returns show that at the opening of the year 1,579,713 tons were under construction in Great Britain and Ireland. The returns issued during 1928 showed a progressive decline for the first three quarters. A distinct improvement was, however, manifested in the last quarter of the year, and on December 31st, 1928, the tonnage under construction in Great Britain and Ireland amounted to 1,242,794 tons, that figure being 336,919 tons less than the corresponding total twelve months earlier. The figures for the end of 1928, showed a reduction of 646,000 tons, as compared with the average tonnage being built during the twelve months immediately preceding the war.

OTHER COUNTRIES.

Particulars of Total Output.—There were launched abroad during the year 449 merchant vessels of 1,253,319 tons—177 steamers of 464,318 tons, 226 motorships of 755,313 tons, and 46 sailing vessels and barges of 33,688 tons. The figures show an increase of 193,513 tons, as compared with those for 1927, though they are still 147,410 tons lower than those for 1913, during which year the highest pre-war total was reached.

Size and Type of Vessels.—The returns for the year include 32 vessels of between 4000 tons and 6000 tons each; 43 of between 6000 tons and 8000 tons; 26 of between 8000 tons and 10,000 tons; and 13 of over 10,000 tons each, the largest being the turbine steamers "Bremen" and "Europa," each of about 46,000 tons, launched respectively at Bremen and Hamburg. There were launched during the year 22 vessels of a total tonnage of 223,489 tons to be fitted with turbines. This total includes one vessel of 20,773 tons, in which the turbines are used in conjunction with electric motors, and nine vessels of 45,069 tons, which have a combination of reciprocating engines and steam turbines. Of the 22 vessels, four are of more than 10,000 tons each. Excluding vessels of less than 1000 tons, the output abroad for the year also comprises 22 vessels, of about 180,000 tons, built on the Isherwood system of longitudinal framing, the "Bracketless" design being adopted in nine vessels of about 72,000 tons. Including all these vessels, there were launched during the year 48 vessels of about 346,000 tons for the carriage of oil in bulk. Of these tankers, 40 of about 305,000 tons are fitted with oil engines. During 1928 there were launched 226 vessels of 755,313 tons to be fitted with internal-combustion engines, as compared with 174 of 507,915 tons in 1927. Sixty-one of those launched during the year are of over 6000 tons each, including seven of 10,000 tons and upwards. Of those exceeding 6000 tons, 15 were launched in Germany, 10 in Sweden, 9 in Denmark, and 7 each in France and Holland; the three largest being one of 20,223 tons and one of 15,500 tons, built in Germany, and one of 16,780 tons, built in Japan. The total figures for motorships include a few yachts and other sailing vessels fitted with auxiliary power. Of the steam tonnage launched abroad during the year, about 250,000 tons are fitted for burning oil fuel. The tonnage of wood vessels included in this year's total is 19,484 tons, as compared with 17,273 tons in 1927. With the exception of six vessels of 1005 tons, the totals for sailing vessels and barges—46 of 33,688 tons—are composed of craft which cannot be described as real sailing tonnage. The countries in which the largest output took place during the year under review are Germany, Holland, Denmark Sweden and Japan. The totals for these countries amounted to 892,457 tons, and account for 71½ per cent. of the total output abroad.

Germany.—During the year under review, 81 vessels of 376,416 tons were launched. As compared with the output for 1927, the present figures show an increase of 86,794 tons, and represent 30 per cent. of the total output abroad during 1928, as compared with 27½ per cent. in 1927. These figures include 15 vessels of 164,813 tons to be fitted with steam turbines, including the two largest vessels launched in the world during 1928, viz., the "Bremen" and "Europa," each of about 46,000 tons. The totals for turbine vessels include nine vessels of 45,069 tons, which will have a combination of reciprocating engines and steam turbines. The total figures comprise, also, 36 vessels of 177,338 tons to be fitted with oil engines, the largest being the motorships "Kungsholm," of 20,223 tons, and "St. Louis," of about 15,500 tons. Two tankers, of 14,109 tons—one a motorship of 11,500 tons—were launched. The totals include 12 vessels of between 6000 tons and 8000 tons, eight of between 8000 tons and 10,000 tons, and the five vessels specified above exceeding 10,000 tons each.

Holland.—The total tonnage launched during 1928—166,754 tons—was 46,964 tons higher than the 1927 figures. As usual, the figures for the country do not include craft exclusively intended for river navigation, the total tonnage of which vessels reaches a high figure. Ten vessels of over 6000 tons each were launched, of which, three steamers of 24,486 tons, are fitted with steam turbines, including the largest vessel launched in the country, viz., the "Nieuw Zeeland," of 10,906 tons. The totals for the year include 43 vessels of 85,132 tons to be fitted with internal-combustion engines. Seven motorships are of 6000 tons and upwards, the largest being the "Poelau Laut" and "Poelau Roebiah," of about 10,000 tons each. Excluding ships of less than 1000 tons, seven vessels, of 41,925 tons, are intended for the carriage of oil in bulk. Five of these, of 36,744 tons, are motorships.

Denmark.—The tonnage launched during 1928—138,712 tons—was 66,674 tons higher than in 1927, and is the highest recorded in this country, exceeding the combined output for the six pre-war years 1908–1913. The total is composed almost entirely of motorship tonnage—133,768 tons. Eleven motorships of between 5700 tons and 9200 tons were launched. All of them, together with another motorship of 3100 tons, are intended for the carriage of oil in bulk, nine, of 67,824 tons, being built on the longitudinal framing system.

Sweden.—The output for 1928—106,912 tons—was 39,551 tons more than that for 1927, and is the highest ever recorded in this country, being slightly in excess of the total output for the ten pre-war years 1904–1913. Nearly 97 per cent. of the total is composed of motorships, of which six are of between 5000 tons and 8000 tons, and six between 8000 tons and 10,000 tons each. The tankers launched—all motorships—amount to ten, of 81,060 tons.

Japan.—The output for this country—103,663 tons—showed an increase of 61,304 tons over the total for 1927, and is the largest figure recorded for this country since 1921. The 1928 totals comprise 18 motorships, of 58,784 tons, including the "Asama Maru" of 16,780 tons, and four others exceeding 6000 tons each. Two turbine steamers, of 10,325 tons, were launched, and three vessels, each exceeding 7000 tons for carrying oil in bulk.

United States.—The output for the year 1928, namely, 91,357 tons, compares with 179,218 tons launched during 1927, and is the lowest recorded during the last thirty-two years. Of the tonnage launched, 22 steamers and motorships of 53,195 tons and 30 barges of 24,805 tons were built on the Atlantic Coast, six steamers and motorships of 5265 tons on the Great Lakes, and five vessels of 8092 tons on the Pacific Coast. The largest vessels launched during 1928 were the turbo-electric vessel "Virginia," of 20,773 tons, built at Newport News, and the motorship "Mary Ellen O'Neil," of 11,628 tons, built at Chester, Pa.; with the exception of a motor tanker, of 8942 tons, launched at Chester, Pa., no other ship exceeding 4000 tons was launched. Two turbine steamers of 23,865 tons were launched in this country during 1928, including the above-mentioned "Virginia," which is fitted with turbines in conjunction with electric motors. Internal-combustion engine tonnage launched amounted to 28,085 tons. Of oil tankers of 1000 tons and upwards, three of 23,505 tons were launched. The totals include four vessels of 21,770 tons built on the Isherwood system of longitudinal framing.

France.—The output for the year—81,416 tons—was 37,081 tons higher than that for 1927. The motorship tonnage launched, 54,764 tons—was more than double the steam tonnage, and included three vessels of between 8000 tons and 8300 tons, each, and four between 6000 tons and 8000 tons. Two steamers exceeding 7000 tons each were launched. Seven vessels, of 53,863 tons, are intended to carry oil in bulk, and, with the exception of one steamer, of 7670 tons, are fitted with internal-combustion engines.

Italy.—The total figures for this country—58,640 tons—were 42,436 tons lower than those for 1927, and were lower than in any year since 1917. Of the total output, 19 vessels of 48,436 tons were launched in the Trieste district. The totals for Italy comprise three steamers of 18,417 tons, intended for carrying oil in bulk, including the "Juvenal," of 13,247 tons, launched at Trieste. There were also launched 15 motorships, of 35,552 tons.

SHIPBUILDING ABROAD DURING THE YEAR.

Dealing with the combined totals for the work in hand in the various countries abroad, a decrease took place during 1928. At the beginning of the year the tonnage under construction amounted to 1,539,008 tons, while at the end of December the total was 1,375,207 tons, a decrease of 163,801 tons. This decrease, however, was not general; while in some countries there was a considerable reduction of the work in hand, in other countries a considerable increase took place. The countries which showed the largest decreases were:—Italy, 89,900 tons; Germany, 89,873 tons; and the United States, 49,421 tons; while considerable increases have taken place in Japan, 49,710 tons; and France, 46,537 tons. The returns for the fourth quarter show that at the end of 1928, the countries abroad having the largest amount of tonnage under construction were:—Germany, 382,422 tons; Holland, 182,229 tons; France, 161,566 tons; Japan, 118,580 tons; and Sweden, 99,244 tons.

SUMMARY OF WORLD'S OUTPUT.

The total output during 1928 reached 2,699,239 tons. These figures represent an increase of 413,560 tons, as compared with 1927. As compared with 1913, during which year the pre-war world's record output was reached, the present figures still show a decrease of over 600,000 tons. The output in Great Britain and Ireland represented 53·6 per cent. of the world's output during 1928, being exactly the same proportion as in 1927.

Some interesting facts may be gathered from this summary as regards the special types of vessels and machinery included in the output of the year under review. The total launches comprised 37 vessels, of over 361,000 tons, to be fitted with steam turbines, including eleven vessels having a combination of steam turbines and reciprocating engines. During 1928, vessels totalling 1,183,229 tons in which internal-combustion engines are being fitted, were launched. This tonnage compares with 863,694 tons launched in 1927. The present total is equal to 80 per cent. of the world's output of *steam tonnage*, as compared with about 62·8 per cent. in 1927. It should be stated, however, that the tonnage of motorships being built in the world at the beginning of 1929 was actually 184,000 tons larger than the *steam tonnage* under construction. Of the total steam tonnage—1,477,092 tons—launched in the world, some 460,000 tons refer to steamers fitted for burning oil fuel under the boilers, so that the tonnage depending exclusively upon coal for propulsion is less than 34 per cent. of the world total for 1928. The tankers launched during 1928 amounted to 99 vessels of 646,851 tons, as compared with 542,437 tons in 1927.

It will be of interest to compare the total of the world merchant fleets in 1914 with the latest available figures. Disregarding sailing vessels and all wood vessels, in view of their comparatively small importance in international trade, the gross tonnage of *seagoing* steel and iron steamers and motorships amounted in June, 1914, to 42,514,000 tons, while at June, 1928, the figures reached 61,594,000 tons—an increase of over 19 million tons.

A remarkable change has taken place in the total tonnage of some types of vessels included in the above figures. For instance, the tankers which in 1914 totalled 1,479,000

tons, now amount to 6,544,000 tons; and motorships, which in 1914 only reached 234,000 tons, now amount to 5,432,000 tons—including auxiliaries. A great change has also taken place in the relative use of coal and oil fuel for boilers. In 1914 the gross tonnage of the steamers fitted for oil fuel was 1,310,000 tons, whilst the 1928 figures show over 19,000,000 tons.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RAILWAYS CROSSING ON THE LEVEL.

SIR,—I was much interested in your note on the above and at some future date should like you to give a complete list of all level crossings of railways in Great Britain, with the crossing lines and where located.

Altogether, as far as I remember from a trip on the East Coast route in 1881, I noticed no less than four, two mentioned by Major Horace Myers, and one at York, the other at Darlington.

One can be seen at Westbourne Park, where a single line from the G.W. runs across a double line of the Metropolitan—Hammersmith and City line—but this line from the G.W. appears to be used principally as a siding for a hay depôt.

The one mentioned by you at Highbridge, Somerset, is very awkwardly situated, as the single line of the Somerset and Dorset Railway runs over a double line of the Great Western, and the single line crosses at an angle, the view being somewhat obscured by a masonry overbridge which carries a road over the G.W. on the east. Both north and south after crossing the G.W. the Somerset and Dorset branches into a double line. A single line spur from the S. and D. connects with the up line of the G.W. to the west, and connection is made with up and down lines of the G.W. by means of a cross-over road.

In your notes you mentioned Sandby Junction, but this, I consider, should read "Sandy Junction," and if this is correct there is no level crossing at this place, as the former L. and N.W. crosses over the G.N. by an overbridge and runs into Sandy Junction by what appeared to me a steep down gradient.

A. M. BUSHELL.

London, February 11th.

[(1) The other two crossings mentioned as on the East Coast route are dealt with in our Railway Matters column this week. (2) The crossing at York is rather an ordinary connection than the intersection of two lines. It was made necessary when York was converted on June 25th, 1877, into a through station, and has a counterpart in the crossing of the main line from the South over the goods lines to the West at London-road Junction, Derby. (3) We had forgotten Westbourne Park. It provokes a reference to the former crossing on the level of the Hammersmith and City line over the Great Western main line at Subway Junction—opened on June 13th, 1864—which we will mention on a later occasion. (4) Our previous note said "Sandby branch," not "Sandby Junction." Obviously the Bedford and Sandy branch was intended.—ED. THE E.]

RAILWAYS AND FOREIGN PRODUCE.

SIR,—My attention has been called to a paragraph in your issue of January 4th, 1929, in which reference is made to the evidence which I gave before the Royal Commission on Transport on December 20th last year. In this paragraph, while paying a tribute to the accuracy of railway witnesses, you ventured to point out an inaccuracy in my evidence which I think you will find on examination cannot be justified. The reference which I made to a case against the old London, Brighton and South Coast Railway Company was based upon my recollection of litigation which took place twenty years ago. I find on referring to the litigation in question that my memory was quite accurate. If you will refer to the case of the Guernsey Mutual Transport Company and William Entwisle *v.* the London, Brighton and South Coast Railway Company and London and North-Western Railway Company, reported in Vol. XIII. of the Railway and Canal Traffic Cases at page 153, you will find that the point under discussion before the Royal Commission was dealt with in the judgment of the Court of the Railway and Canal Commission, presided over by Mr. Justice A. T. Lawrence, as he then was.

I trust that you will have the courtesy to find space in your next issue to remove the implication against my accuracy.

H. L. THORNHILL.

London, February 7th.

L.M.S. HIGH-PRESSURE LOCOMOTIVE.

SIR,—I do not follow Mr. Keiller's reasoning. How can the fact that other types of compound locomotives have been found unsatisfactory be a ground for rejecting a type which has been uniformly successful?

On a spring afternoon in 1882 I saw the first of the Webb three-cylinder compounds, the forerunner of all modern compound locomotives, on its first journey in regular service; and since that date I have seen compounds of all sorts and sizes, with two, three, or four cylinders, in various parts of the world, and can well believe that most of them have been failures. But by skill or, if Mr. Keiller prefers it, by good luck, the French hit upon a design which has done superlatively good work, and I regret that we in this country have not taken advantage of it.

Mr. Keiller quotes figures of coal consumption, but these do not go very far. They are valueless unless the engines compared are supplied with exactly the same quality of coal and are doing exactly the same work under exactly the same conditions. And those of us who remember locomotive controversies in the past know that coal consumption figures have a mysterious faculty for proving just what the particular experimenter wishes to prove.

And in any case coal consumption is not everything. For example, the Whale "Precursor" engines on the L. and N.W.R. were extravagant coal burners, but we all know with what relief they were welcomed after the curiosities of the last twenty years of the Webb *régime* at Crewe.

W. B. THOMPSON.

London, February 9th.

Low-Temperature Carbonisation.

THE following remarks were made by Dr. H. E. Armstrong after the Chairman's speech at a meeting of the South Metropolitan Gas Company on Wednesday last.

I am naturally interested in paragraph 7 of your report, having often urged you, at these meetings, to take notice of low-temperature fuel. Your announcement, together with that made at the recent Gas Light and Coke meeting, may well mark a new era in gas companies' policy. It may even happen that in future practically all the coal burnt in our towns will pass through the companies' hands. I can foresee a very great burden coming upon you; I believe it to be one you can shoulder.

It is amazing, however, that you should be paying for the privilege of doing what was once your practice. Call it "Coalite" or what you will, the material you are to supply will be the soft coke produced in the early days of the industry, so long as iron retorts were used. It was greatly esteemed by the public. Gradually, as the temperature of carbonisation was raised and more and more gas squeezed out, the value of the coke as a domestic fuel went down and down, almost to nil.

You are making an experiment of the highest public importance. No proper steps have been taken thus far to place the soft coke industry upon an economic basis. It has been in the hands of men who have been full of enthusiasm, but correspondingly ignorant of the science of the industry they have sought to establish—unable to appreciate and solve its problems. The public has been greatly misled; false hopes have been raised. The solid fuel produced is the one asset of the process, the only present asset. The oil—it cannot be called tar—has little present value; you will probably have to discover how to make it into tar—alternatively, to hydrogenise it. The gas cannot be directly mixed with your gas. Strange to say, it is too good. It would upset the air-gas balance proper to the perfect burners with which your customers are supplied. Probably you will need to spend money upon it to make it of use. Five years hence—scarcely sooner—you may be able to tell us what the economics of the process are.

During the period we shall have learnt so to worship soft coke that you will be forced to produce it, willy nilly. Meanwhile you will have to do many things, if not yourselves, through the agency of those who supply you with coal. The public will soon insist upon their fuel having a low ash and upon the almost complete absence of volatile sulphur.

An absurd fuss is made by academic folk about the soot from our fires; it helps to protect our buildings. The real enemy is dust, dust from the streets and dust sent up the chimney. The central power station may well be our greatest enemy; if we do not force it entirely to consume its own smoke. Another source of evil are the salts volatilised with the smoke, especially chloride and sulphate of ammonia and also sulphur dioxide. These all attack stone and ironwork when these are not protected by soot.

Finally, with your aid, we shall return to the worship of the open fire and scrap most central heating—an invention of the enemy. The animals at the Zoo are proving this; however much they were warmed they were unhappy. Now that they have a fire to look at, we are told, they not only sit up and take nourishment, but scamper about freely, as if in the wilds of Nature. Bank clerks and others, now confined in centrally heated concreted cellars, without daylight, unable to open a window, will flock to your shrine—a large open fire—praying to be delivered from the faults of an unholy, unhealthy civilisation.

Books of Reference.

"THE Concrete Year Book, 1929." By Oscar Faber, D.Sc., M. Inst. C.E., and H. L. Childe. London: Concrete Publications, Ltd., 20, Dartmouth-street, S.W. 1. Price 3s. 6d. net, post free 4s.—This, the sixth annual edition of this handbook, is a thorough revision of the last issue, and it embodies an additional 100 pages of matter. The volume is, as usual, divided into three sections, namely:—Handbook, Directory, and Catalogue. The Handbook section contains a mass of information regarding cement, concrete, and concrete design and construction, and forms a most useful source of knowledge on these matters. The Directory comprises lists of designers, contractors, plant manufacturers, &c., together with a handy list of trade marks and brands. The Catalogue gives particulars of the products of some 300 firms connected with the concrete industry.

"THE Practical Engineer Mechanical Pocket Book and Diary for 1929," published in London by Humphrey Milford, 11, Warwick-square, E.C. 4, price 2s. 6d.—This, the forty-first edition of this useful little book of reference, contains as additional features a number of new notes, while notes which appeared in previous issues have been altered to bring them up to date. In his preface, the editor points out that important additions and alterations have been made under the headings:—Water-tube Boilers; Boiler Mountings; Water Softeners; Feed-water Regulators; Steam Valves; Thermostatic Regulators; Oil and Diesel Engines; Friction Linings; Friction Clutches; Chain Gearing; and Gas-heated Furnaces; while particulars are also given concerning recently issued British Standard Specifications relating to Steels, Cast Irons, Bolt Heads, Nuts, Washers, Twist and Straight-fluted Drills, and Morse Tapers. As usual, there are included a buyers' guide and technical dictionaries in French, Spanish and Russian.

"THE City of Birmingham Handbook, 1928–1929." Birmingham: Published for the Corporation by the General Purposes Committee, 1929.—In connection with this year's British Industries Fair at Castle Bromwich, Birmingham has prepared for distribution among visitors a handbook bearing the foregoing title. It has been compiled and edited by Mr. W. S. Body, who is chief clerk in the Town Clerk's office, and it is divided into nineteen sections, following a foreword by the Lord Mayor and an introduction. The various sections deal with the following subjects:—I., The Town of Birmingham, the City Council, &c.; II., Public Buildings, &c.; III., Public Works—Sewage Disposal; IV., Town Planning; V., Public Health, &c.; VI., Education; VII., The City Estates, &c.; VIII., Police and Fire Protection; IX., The Salvage Service; X., Weights and Measures; XI., Baths and Washhouses; XII., Finance; XIII., Gas: Light, Heating and Power; XIV., Water Supply; XV., Electricity: Light, Heating and Power; XVI., The Transport Service; XVII., Markets; XVIII., The Municipal Bank; XIX., Other Points of Interest. The volume should fulfil its designed purpose well. It is excellently got up and printed and is commendably well written. It is well printed, the type used is easily read, and there are numerous first-rate illustrations.

"*Mechanical World*" Electrical Pocket Book, 1929. Manchester: Emmott and Co., Ltd., 65, King-street; and London: 20, Bedford-street, W.C. 2.—This little book, which has now reached its twenty-second year of publication, contains several novelties. For examples, sections devoted to electric winders for collieries, electric driving in steel works, and turbo-alternators have been introduced. Then, too, much of the matter in the early sections has been extended to cover direct-current generators and motors, and synchronous, induction, auto-synchronous, synchronous-induction, and traction motors. Further additions include a section on automatic sub-stations; data relating to condenser calculations; and various new tables of a miscellaneous character. In other respects the volume appears in its customary form.

"*Mechanical World*" Year Book, 1929. Manchester: Emmott and Co., Ltd., 65, King-street; and London: 20, Bedford-street, W.C. 2. Price 1s. 6d. net.—This is the forty-second year of publication of this handy little book of reference. In it various new sections have been introduced. First, there is one on helical springs, in which—to quote the preface—"an endeavour has been made to eliminate many of the troublesome calculations which are usually necessary, while giving a deal of useful information on the subject generally in concise form." Then there are sections giving notes and data on fly-wheel proportions and on compressed air. Tables on mild steel tubes, wire ropes for cranes, and valve rod ends have been included, while additions have been made to the sections on belt conveyors and revisions effected in other sections.

"THE Electrical Trades Directory and Handbook, 1929." Published by Ernest Benn, Ltd., Bouverie House, 154, Fleet-street, London, E.C. 4. Price 25s. net.—The "Blue Book," to give it the name by which it is universally known, appears in the present edition for the forty-seventh year in succession. We are informed that it contains more matter than have any of its forerunners, though by the use of thinner and stronger paper it is claimed to have been made much handier to use, albeit the thinner paper has not made its pages more difficult to read. The contents have been, so the preface tells us, thoroughly revised and brought up to date. The Geographical Section for Great Britain, Scotland and Wales, which was introduced for the first time in last year's volume, has been much amplified, and Northern Ireland is now included. Another new feature is a list of contractors in which the names of those who are on the National Register, members of the Electrical Contractors' Associations of this country and Scotland are distinctively marked. We note that the use of the thumb guide cards has been extended so as to render more easy the finding of the various sections.

B.E.S.A. SPECIFICATIONS.

LOCOMOTIVE, CARRIAGE AND WAGON TIRES.

A REVISED edition of Part 2 of Report No. 24 B.S. Specification for Locomotive, Carriage and Wagon Tires has just been issued by the British Engineering Standards Association. This issue supersedes the previous edition which was published in 1921. The present revision has been undertaken to effect certain changes in order to bring the specifications into line with present-day requirements. The principal alterations which have been made include the limiting of the sulphur and phosphorus content for locomotive tires, and also for carriage and wagon tires of classes D and E, to 0·04 per cent., Clause 5—number of tires to be tested—has been re-drafted in the light of experience to render it more explicit, and Clause 8—additional tests before rejection—has been amplified to allow heat treatment or re-heat treatment of the tires to be carried out in the case of failure under the Falling Weight Test before final rejection.

Copies of this specification may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, S.W. 1, price 2s. 2d., post free.

THE Canadian Pacific Railway Company is carrying out trials of the welding of rails, by means of the electric arc, with the idea of strengthening the joints at fish-plates.

OMNIBUS WITH DOOR CONTROL AND AIR BRAKING

G. D. PETERS AND CO., LTD., SLOUGH, ENGINEERS

Omnibus Braking and Door Control.

A FEW days ago we were invited to inspect at the works of G. D. Peters and Co., Ltd., Slough, a demonstration omnibus which the firm has recently fitted out, in order to exhibit to its customers in various parts of the country, the special systems of air braking and electro-pneumatic door control, along with other features of body work and fittings, in which the firm specialises.

The vehicle which has been chosen for this purpose is a standard type of forward drive, low loading omnibus manufactured by the Associated Daimler Company, Ltd., of Southall. In designing the car special care was taken so to load the chassis, that, in the light condition, with a complement of the driver and one or two observers, the weight is equivalent to the full load of thirty-two passengers. This being so, road tests equivalent to those with a fully loaded vehicle can be carried out at any time. We show above a side view of the omnibus, the body of which was built by Christopher Dodson, Ltd., of Willesden. The panel work, both of the body and ceiling, is composed of the special "Sundeala" millboard, which is manufactured by G. D. Peters, Ltd., and now applied to all kinds of rolling stock. The windows and seats are also representative of the various standard types of such fittings which are supplied by the firm.

It is with the braking and door controls and their means of operation that we are, however, more immediately concerned. The omnibus is designed so as to be equally suitable for either "one-man" or "two-man" operation. When in charge of a single driver-conductor a special feature is introduced, namely, a sliding driver's seat, which enables the driver to move to the left of his controls in order to issue tickets and take fares from his own driving compartment window. This provision, together with the electro-pneumatic control of both the entrance and exit doors, which is interlocked with the power braking system, gives a convenient and safe method of operating the vehicle by a single man. The two mechanically-operated doors are shown opened and both of them are of the two-leaf single folding type, being swung from vertical door shafts which are housed in ball bearings and worked by a pneumatic door engine, which is under the control of an electro-pneumatic valve operated from the dashboard and energised from the 12-volt car lighting battery circuit.

The passenger entrance is arranged at the front of the vehicle and has a door of the inward folding type, while the rear door, which is used for exit only, is of the outward folding type and is furnished with a double treadle plate control.

The door engines, which are, we understand, generally of the same type as those used on the Underground Railways, incorporate a cushioning effect which gives a slight check to the door at the end of the closing movement. This feature, together with the use of patented rubber edges on the door, is claimed by the makers to have eliminated all risk of injury to passengers should they inadvertently become trapped in the door. At the same time any injury to the body work of the omnibus will also be obviated. The system is so designed that, except in the case of an emergency, the doors cannot be opened until the omnibus has come to rest under the action of its brakes. For garage and emergency purposes release valves are fitted to the door engine cylinders, which can be operated from the outside of the omnibus. In addition to the two master switch controls for the doors which are fitted on the dashboard, there is also another control switch near to the rear door which can be worked by the same key. In the case of "two-man" control the driver gives his key to the conductor and is only concerned himself with the automatic operation of the doors in conjunction with the braking system. Within the body of the omnibus there is a passenger emergency switch in the power circuit, which, when tripped by pulling a chain, immediately opens both the doors.

In Fig. 1 we show a general view of the engine with the special chain drive for the air compressor unit supplying the power for the operation of the doors and brakes. The air compressor was designed by Reavell and Co., Ltd., o Ipswich, which firm has collaborated with Messrs. Peters in this work. The compressor is driven from the engine magneto shaft and it is a two-cylinder unit, complete with its own air cooling and lubricating system. It is designed to run for long periods without any attention whatsoever and without overheating. At a speed of 1175 revolutions per minute the output is about 3 cubic feet of free air per minute, and the power taken does not amount to more than 0·30 horse-power. This power is, however, intermittent, as the set is provided with an air-operated clutch working in conjunction with the air storage receiver. When the required working pressure of 70 lb. to 90 lb. has been attained the compressor is automatically cut out by the clutch and only comes into operation again when a further supply of air is required and the pressure has fallen below a pre-arranged limit.

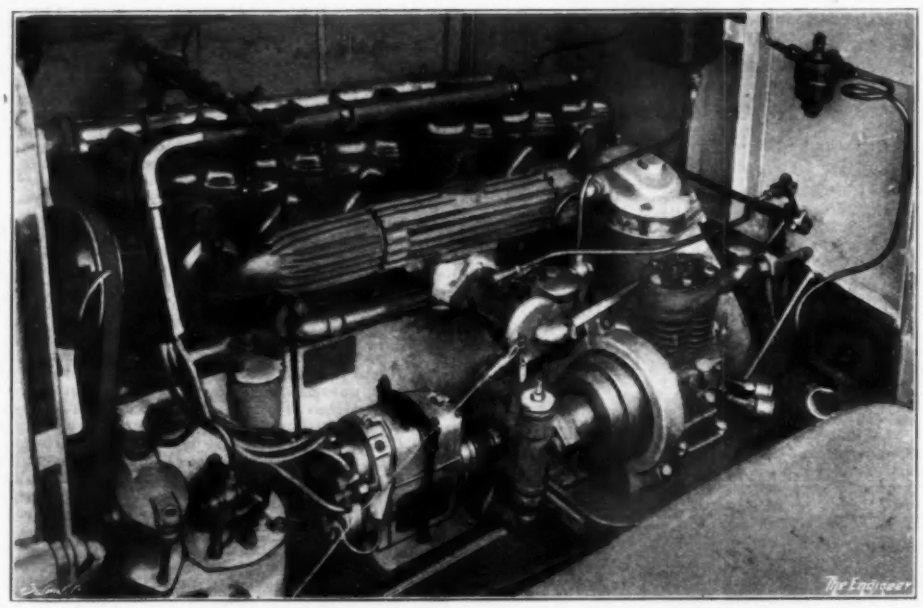


FIG. 1—ENGINE AND CHAIN-DRIVEN AIR COMPRESSOR

The braking system, which is shown diagrammatically in Fig. 2, is of the type made by Messrs. Peters' associated company, the Consolidated Brake and Engineering Company, Ltd., which has, we learn, already been successfully employed on tramway cars and trolley omnibuses. As the drawing shows, the braking system is a direct one, and as it is operated by compressed air, little or no physical effort is required on the part of the driver. The design is such that the brake cylinder gear and the driver's control valve, the design of which has been registered under the name of the "Uniped" valve, can quite well be applied to the existing foot brake gear of any chassis, leaving this gear unimpaired for use at any time, should the air supply at any time fail. The brake cylinders are robustly constructed and the piston is of the leather cup type, having a travel of a little over 2in., the length of which effectively compensates for any unequal wear in the brake linings or rigging. The car we inspected had run over 3000 miles on its initial valve setting with no change in the braking effect. The control valve, which is coupled directly to the foot brake pedal, is of a very simple type, and it is designed to distribute air to the four cylinders without any time lag.

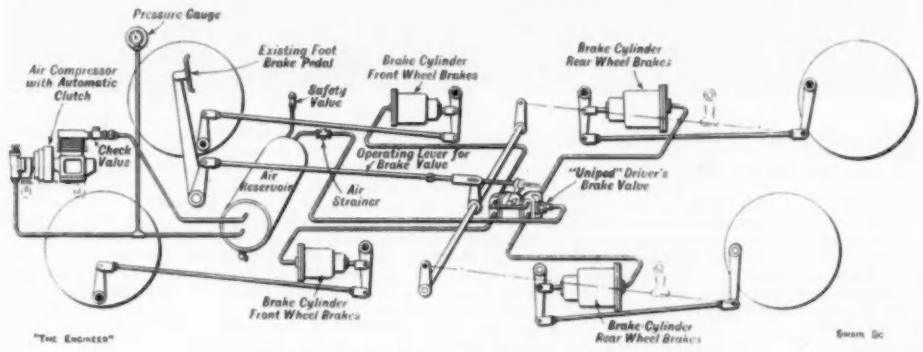


FIG. 2—DIAGRAM OF AIR BRAKING MECHANISM

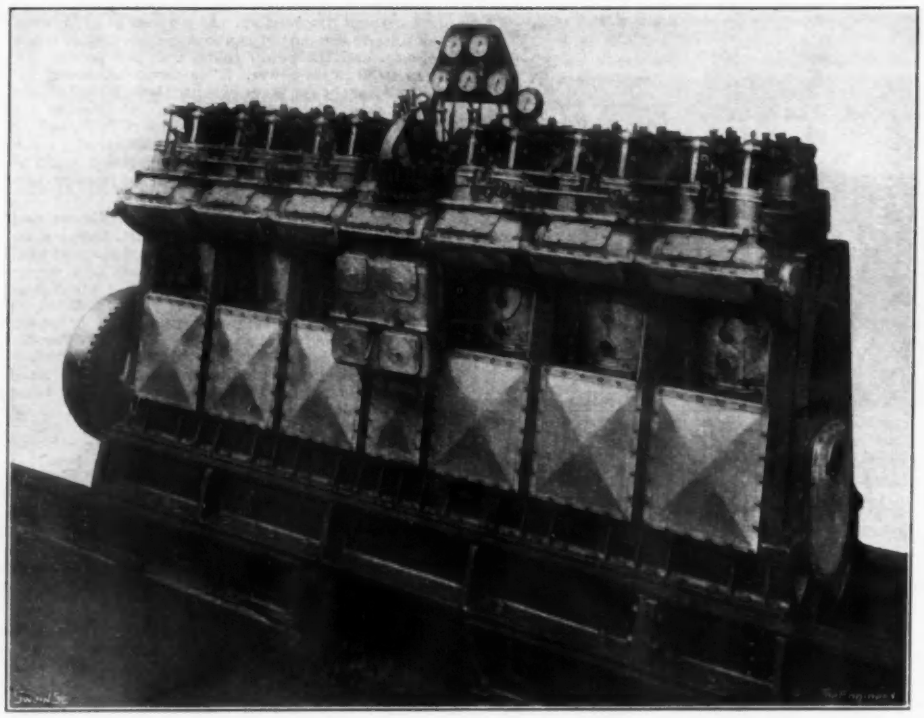
The brake release is also instantaneous. We were able to test the braking of the omnibus for ourselves, and we found that it was both smooth and efficient in actual operation. When the omnibus was run up to a speed of 25 miles per hour on a fairly level road it was brought to a standstill in 15 yards from the point at which the brake was first applied. At a speed of 30 miles per hour the vehicle has, we were informed, been brought steadily to rest in three seconds, compared with seven and a-half seconds which is required when the foot pedal was used without the pneumatic braking. Another valuable feature of the system is the possibility of applying a small braking effect of, say, 5 lb. pressure in the cylinders by very slightly depressing the brake pedal. This enables a driver to maintain full control of his omnibus in crowded traffic and to draw up at stopping places with greater ease than is possible with hand braking systems. The application of this air braking system to omnibuses, lorries and commercial vehicles is, we understand, new, but it seems to offer a wide field of development, and the particular vehicle we have described seems to be very suitably equipped for its demonstration.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—The annual dinner of the Finsbury Technical College Old Students' Association will be held at the Trocadero Restaurant on Friday, March 1st, at 6.30 for 7 p.m., when the chair will be taken by the President, Mr. E. W. Moss, M. Inst. Mech. E., A.M.I.E.E., F.C.S. The dinner this year will celebrate the jubilee of the opening of Finsbury, and it is hoped that there will be a large attendance. Further particulars can be obtained from F. R. C. Rouse, hon. secretary, 15, Clifton-gardens, Golders Green, London, N.W. 11.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—At the annual dinner of the Institution of Electrical Engineers, held at the Hotel Cecil on Thursday, February 7th, it was announced that the Prince of Wales had consented to become an honorary member of the Institution. Over 600 members and guests were present, and Lieut.-Colonel K. Edgcumbe presided. In toasting the Institution, Lieut-Colonel C. B. Levita, chairman of the London County Council, referred to what the London Council had done in the way of encouraging the use of electricity, and observed that electrical progress owed much to the improved facilities for education. In responding, the President, Lieut-Colonel K. Edgcumbe, said that he had recently been interested in the Board of Trade cost of living index, so far as it concerned fuel and light. He found from the figures that the item was put at 70 per cent. above the pre-war cost, but as electricity was cheaper than it was before the war, he decided to make inquiry, and then discovered that, apparently, the Board of Trade had never heard of electricity. The only fuel and light they allowed the man-in-the-street were coal, oil, candles and gas. He ventured to think that it was about time the Board of Trade revised its index. The Earl of Clarendon, chairman of the British Broadcasting Corporation, responding to the toast of "The Guests," proposed by Mr. W. B. Woodhouse, said that he believed that one in every three house in the country was now equipped with some form of wireless receiving instrument, and there were about 12,000,000 regular listeners. He believed that the forces that made for discord would come to recognise that in wireless they had a most formidable and relentless foe. Mr. H. T. Tizard, secretary of the Department of Scientific and Industrial Research, also replied.

750 B.H.P. FOUR-STROKE HIGH-SPEED OIL ENGINE

VICKERS-ARMSTRONGS, LTD., BARROW IN-FURNESS, ENGINEERS



A Six-cylinder 750 B.H.P. Light Weight Oil Engine

In the course of a visit paid to the Naval Construction Works of Vickers-Armstrongs, Ltd., at Barrow-in-Furness, we recently saw in course of construction and on the test bed, examples of a new type of high-speed lightweight oil engine, which we show in the accompanying engravings. The design is noteworthy for the care which has been taken in reducing the weight of parts without sacrificing essential strength. The new engine is one which the makers state is suitable both for the smaller class of submarines and for auxiliary lighting sets, while it can possibly be employed for oil engine drives on locomotives of the oil or oil-electric type. The engine is non-reversing and the absence of reversing equipment introduces additional simplicity, particularly with regard to the cam shaft. It is a six-cylinder four-stroke unit, with the fuel pump and the controls placed at the centre of the engine.

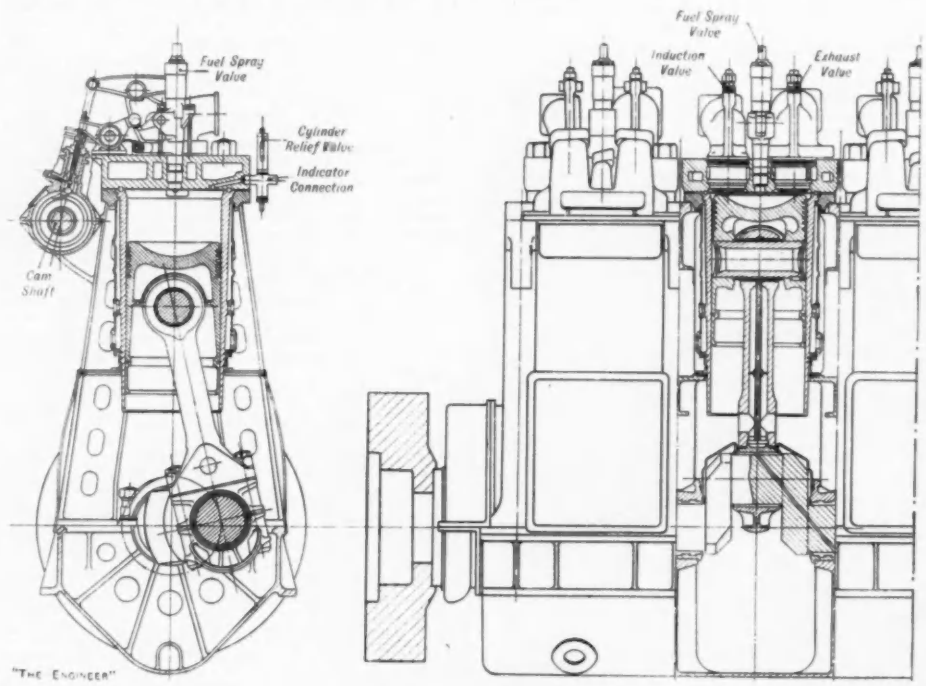
The cylinders have a bore of 14in. with a stroke of 14·8in., and at a full power submarine rating the output is 750 B.H.P. at 450 r.p.m. When employed as a continuously running engine for electric power, 300 kW may be developed at a running speed of 350 r.p.m., that rating being such that a 25 per cent. overload is then available over long periods.

The view reproduced above shows the external appearance of the engine, which is clean and neat, while two typical sections through the cylinder and crank shaft are shown in the accompanying drawing. The type of bed-plate may be modified to suit the conditions of service, and we show a bed-plate of the submarine type, which is made in cast steel. It is light in section and is strengthened by well-placed ribs. For dynamo driving, a deeper form of bed-plate, made either in cast iron or cast steel, and furnished with an oil sump, is employed. The engine weight will vary, of course, slightly with the type of bed-plate adopted, but the submarine type of engine illustrated works out, we are informed, to about 13·7 tons, or at the above-mentioned rating about 40 lb. per B.H.P.

In order to obtain such a saving in weight, considerable care has been exercised in the design of detail parts. We have already referred to the light ribbed steel bed-plate. The crank shaft is made in two halves, and is forged solid in oil-toughened steel. All the main bearings consist of steel shells fitted with white metal linings. As will be observed, the cast steel columns, which are of light ribbed section, straddle the main bearings.

Between the tops of each pair of columns there is a forged steel sandwich plate, provided with a turned recess, into which the plain cast iron liner is fitted. The liners are made from special metal, and they pass down through a horizontal tie plate, placed at the level of the top of the crank case. The tie plate serves the double purpose of taking the side thrust of the liner, and at the same time binding the columns together. Above the tie plate, a liner jacket made of thin galvanised steel plate, surrounds the liner and is bolted up to the sandwich plate. At its lower end the jacket joint is a sliding one, made with rubber rings.

As shown in the drawing the connecting-rods are of light section and they are made from solid steel forgings, which are bored, turned and milled to the required shape.



SECTIONS OF ENGINE

A cast steel bottom end bearing is used, and the top end bearing consists of a steel bush pressed into the eye of the rod. Both bearings are white metal lined. The pistons are of the one-piece uncooled type, and they carry six piston rings. The gudgeon pin is made from hardened steel, and the bottom of the piston is furnished with an aluminium oil guard, which prevents the lubricating oil from reaching the piston crown. As the drawing shows, each cylinder cover carries an inlet and exhaust valve, which are slightly offset to accommodate the central spray valve. The cylinder covers are secured to the sandwich plate and the heads of the columns by four through bolts, and the cover joint, which is made by a ground steel ring, is made further secure by eight studs fixed in the sandwich plate.

Special materials are employed for the valves and valve gear. The spray valve itself consists of a steel stamping. The exhaust valves are made from special steel forgings, and they are not of the water-cooled type. Both the inlet and exhaust valves are operated by push rods, which terminate in an aluminium piston which carries the cam rollers, the valve springs being carried on the upper side of the same piston. Provision is made for adjusting the valve travel by means of liners placed beneath the fulcrum brasses of the exhaust and inlet valve levers.

It will be seen that the cam shaft is totally enclosed. As there are no reversing cams, there is room for larger bearing surfaces. The cam shaft is driven by spur gears from the crank shaft, and the fuel pumps, which are placed at the centre of the engine, are driven by four separate excentrics. The pumps deliver the fuel to a common distributor from which branches are taken to each spray valve. Valves are fitted in each of these pipes to enable the supply of fuel to be cut off, while a hand cut-off lever is arranged at the cylinder for the purpose of isolating any given spray valve.

Under normal running conditions all the spray valves are controlled together by a single lever, which rotates the shaft on which the excentrically mounted spray valve levers are mounted. Simultaneously this lever regulates the output of the fuel pump, and there is a separate lever which adjusts the output of the fuel pump independently of the spray valve.

The engine is started by compressed air at the usual pressure of 600 lb. per square inch. The air is delivered to the various cylinders by a series of cam-operated valves in a common valve box, situated at the back of the engine. The supply pipes from the valve lead to each cylinder through a non-return valve placed on the cylinder cover. The non-return valve fitting also carries an indicator connection and a relief valve.

In the case of engines for generator driving, the auxiliary pumps are driven from the end of the crank shaft, but in the particular engine we illustrate only the lubricating oil pump is engine driven. It is placed in the oil sump, and is driven by gearing from the vertical shaft, situated at the centre of the engine, which drives the main cam shaft. Two eight-cylinder oil engines of this type are being fitted in H.M.S. "Medway" for electric generator driving. A full description of the main Vickers-M.A.N. propelling machinery of this ship will be found in THE ENGINEER of August 31st, 1928. The fuel consumption of the type of engine here described is very good. At a submarine rating of 750 B.H.P. at 450 r.p.m. the fuel used per B.H.P. per hour was 0·42 lb. The eight-cylinder "Medway" engines running at 350 kW output and 350 r.p.m. have a fuel consumption of 0·375 lb. per B.H.P. hour, and 0·397 lb. when running at a 50 per cent. overload at the same speed. Under overload conditions brake mean pressures as high as 95·5 lb. per square inch have been maintained without difficulty.

RECENT DEVELOPMENTS IN THE ART OF OIL CRACKING.

IN a lecture on "Recent Developments in the Art of Oil Cracking," delivered by Dr. A. E. Dunstan before the Junior Institution of Engineers on February 8th, 1929, the evolution of the plant employed in producing cracked spirit was described. Cracking as applied to oil was, it was explained, of British and not American origin, as commonly supposed, having been first employed in 1862 in Scotland, where a plant working at 20 lb. pressure was used to turn gas oil into paraffin. The term "cracking" was American, and was suggested by the noise made by oil which had inadvertently been allowed to remain in an overheated still. Gasolene or petrol was the most important fraction of petroleum. Last year 30 per cent. was obtained by cracking crude oil, and a further 20 to 30 per cent. from cracked natural gasolene.

Although the world's consumption of oil was very great, and prophecies of a serious diminution in the oil reserves of the earth were frequently heard, the lecturer stated that during the past seventy years only about two-thirds of a cubic mile had been taken out of the earth.

The researches of the chemist, aided by improvements in plant which those researches suggested, had resulted only this year in the ability completely to break down the constituents of oils and gases and the reassembly of these components in forms which at the moment might be more profitable commercially. There were three essentials in oil distillation over which rigid control must be possible, viz., temperature, pressure and time. An increase of 10 deg. Cent. in temperature reduced by one-half the time required. The choking up of a pipe still system by coke residue had been eliminated by converting the steady flow of oil pumped through the system into a pulsating flow; the pulsations being produced by an auxiliary pump.

In reply to a question as to what was likely to be the effect on the price of heavy oil by cracking so much of it into lighter oils, the author stated his opinion that a simple solution would eventually be found by which the British Thermal Units in any oil or spirit would form the basis of the price charged for it. In answering a question as to the official prohibition of the use of cracked spirit for aviation purposes, the lecturer stated that the reason it had hitherto been looked upon with disfavour was the possibility of its containing a gummy substance; its further refining was now possible whereby the gum forming substance was extracted, and he considered that cracked spirit would in future be permitted for aero engines.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

THE very gradual improvement in the heavy industries throughout the Midlands and Staffordshire continues. Slowly, yet surely, consumptive demand for iron and steel is increasing, and manufacturers' order books present a pleasanter appearance. The forecasting recently by Sir Gilbert Vyle of better times for both the wrought iron and the steel manufacturers of this area, coming from so well-recognised an authority, has cheered local industrialists. All recognise that there are many difficulties still to be surmounted before these trades can be said to be really paying their way. Things are moving in the right direction, however. What is wanted is full employment for works plant, and, as stated above, the volume of orders reaching local mills is becoming larger. Increased reinvigoration of consumptive demand is anticipated, and the bulk of manufacturers hereabouts are looking to the immediate future with considerable hope, meanwhile expressing limited satisfaction with the conditions at present ruling.

Raw Iron Prices.

It is apparent this week that smelters have succeeded in their price-raising policy. Some, if not all, of the Midland smelters who at first were outside the combination, have now been roped in, and with greater unanimity amongst producers, buyers have been forced to concede the increase demanded. As far as can be ascertained, there have been no offers of supplies at below the prices fixed by the smelters in conference. Derbyshire No. 3 foundry was quoted firm at £3 2s. 6d. at furnaces, and forge £2 17s. Northamptonshire foundry was named £2 17s. 6d., and forge £2 12s. In the South Staffordshire district there are no furnaces turning out ordinary pig iron for the market. There is a battery of furnaces at Bilston producing basic pig for affiliated steel plants, and two or three small furnaces are making cold-blast iron and other specialities used mainly in the district. Business in Midland brands of pig iron has flowed rather more freely this week, and orders which had been withheld pending a settled state of prices in the market, have been grudgingly placed. Foundry qualities have been most called for, forgemen's requirements being small. Local foundrymen state that business is on the mend, and they hope to be utilising increasing tonnages of material as the year progresses. Midland smelters will welcome this statement, for now that their prices are nearer to those of Cleveland makers, they can hardly expect to secure business from Scotland and the North which they have recently had on account of their better competitive price position, and they must need a greater bulk of business from local consumers to keep production at its present level. It is trusted that the better prices now obtainable by pig iron makers will enable them to place their industry on a more stable basis. It is admitted that they have had a very trying time of late years, and it is sincerely to be desired that production should be placed on a remunerative basis. More orders and larger are what Midland smelters require. Not until they are forthcoming can the large number of idle blast-furnaces in South Staffordshire and other Midland centres be recommissioned.

Steel Business.

The demand for steel, alike raw and finished, continues to broaden, though constructional engineers are not consuming their normal tonnage for this time of the year. Engineers and makers of rolling stock are placing some good contracts, while automobile engineers are taking steady supplies. One local steel firm producing about 300 tons of free-cutting steel per week, has been compelled to put on a night shift in order to cope with the requirements of its customers in the motor and electrical trades. Native prices are unchanged from those ruling a week ago. Continental prices give no evidence of coming down, and this week there have been very few semis on offer. Delivery dates for foreign material are very indefinite, but most home producers can give almost immediate delivery. Under these circumstances, it is not surprising that native mills are improving their position. There is a splendid demand at date for steel melting scrap, and some difficulty has recently been experienced by consumers in getting adequate supplies. South Wales buyers this week offered £3 12s. 6d. per ton, at which price holders were prepared to sell.

Finished Iron.

There have been no marked changes in the Staffordshire finished iron trade on the week. Business is keeping up, especially in the marked bar department. Midland railway carriage and wagon building firms are taking rather larger quantities than of late, and in those various departments of engineering where best wrought iron is almost invariably used, orders are in prospect which will require for their execution large tonnages of marked bars. Best bar values are maintained at £12 per ton. In the Crown bar branch, conditions are far from satisfactory. Demand is poor and irregular, and internal competition makes the lot of Staffordshire makers an unenviable one. Local makers' prices are still well above those accepted by outside producers. Mills producing nut and bolt and fencing bars are better employed as the result of securing orders which in normal conditions continental makers would have taken. There is no improvement in the consumptive demand, the Darlaston nut and bolt makers complaining at the moment of bad trade, due to the depression in their chief consuming industries. Prices range from £8 10s. to £8 17s. 6d. Wrought iron strip for gas and water pipes is in growing demand, and makers have no difficulty in disposing of their output at £10 12s. 6d. South Staffordshire strip mills are more fully employed than they have been for years past, and, with the tendency to return to the use of puddled iron for water pipes by important undertakings, this happy state of affairs bids well to continue.

Galvanised Sheets.

All classes of galvanised sheets are selling well, and most mills are well booked forward. The overseas demand for corrugated sheets is maintained, and the home consumption of black sheets grows weekly. Prices are maintained at the recent level, 24 gauge being on the basis of £13 12s. 6d. and £13 15s. per ton. There are no new features in the tin-plate market here. Demand is steady and prices are unchanged.

Industry Flows Southwards.

The somewhat remarkable figures relating to the flow of industry from the north to the south of the country quoted in the House of Commons this week have provided Midland manufacturers with a topic of conversation. How steady the stream is is shown by the fact that during the past five years the insured population of the North has increased only slightly, and in Wales there has been a diminution. On the other hand, there has been in the Midlands an increase of 7 per cent. in the insured population, yet the ratio of unemployment has gone down. One of the cities mentioned in Parliament as an example was Coventry, where the insured population has increased by 20 per cent., but unemployment has fallen from 6 to 3 per cent.

Australian Boiler-house Equipment Contract.

The Wolverhampton boilermaking firm of John Thompson (Water Tube Boilers), Ltd., has just secured its third large contract from the State Electricity Commission of Victoria. The order is for boiler-house equipment for the Yallourn power station, and is for no less a sum than £220,000. The contract includes eight boilers, each having an overload capacity of 85,000 lb. of steam per hour at 275 lb. working pressure, with superheaters, preheaters, forced and induced draught fans, steel casings, fire-brick linings and pipe work

Canal Bridges.

Birmingham and South Staffordshire industrialists, through the Midland Council of the National Union of Manufacturers, have appealed to the Minister of Transport to give immediate attention to the question of the weak canal bridges in this area, and to make known to what extent the Ministry is prepared to remedy the position. They state their belief that, if the Ministry will agree to grant 75 per cent. of the cost of strengthening the principal bridges which are vital to the carrying on of industry, the local authorities concerned would be prepared to do their part forthwith. It was pointed out that manufacturers' use of certain roads has been restricted by the canal company's action in issuing warnings, and in some cases manufacturers are practically unable to get the goods they manufacture out of their works. The position is a grave one, and it is much to be hoped that the Ministry of Transport will realise the necessity for immediate action.

Unemployment.

The unemployment figures in the Midlands continue to move in the right direction, and in most of the industrial areas the number of persons unemployed is gradually diminishing. The current total of 184,357 is an improvement by 1958 on that of a week ago, and there would appear to be evidence of a continuance of the favourable movement. Birmingham shows a decrease on the week of 317. The Coventry figures, unfortunately, are slightly up, as are those of Bilston, Oldbury, Smethwick, Stoke-on-Trent, and Stourbridge and Brierley Hill.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The Industrial Situation.

IN the course of its monthly comments on industrial conditions generally, the bulletin of the Manchester Chamber of Commerce refers as follows to the engineering trade:—"The engineering trade has been greatly interested in the overhaul of the iron and steel industries which has taken place recently. It is assumed that the changes involved in the amalgamations of producers will strengthen the steel industry's competitive power, and in that event the engineers will benefit by them. Textile machinists are mostly in much the same position as they were in December, but one big Lancashire company, which had not been on full production, made it known that full time was being resumed at the new year. Some big railway programmes have been disclosed, and one important Lancashire firm has many orders on hand for locomotives for export. Electrical and constructional engineers, and also motor-car manufacturers, have been fairly well engaged." In this connection, one or two remarks may be quoted from the somewhat critical speech made by Mr. H. G. Williams, Parliamentary Secretary to the Board of Trade, at a Chamber of Commerce luncheon here on Monday of this week. Manchester, he said, was famous as one of the great engineering centres of the world. Engineering was looking up, and shipbuilding was also looking up. This was a hopeful sign because the reactions of the shipbuilding industry upon the other industries of the country were enormous. He thought, therefore, they had reason to be hopeful with regard to trade prospects. Fuller order books justified greater hopes this year than in previous years.

Modernising an Eighty-year Old Line.

Work preparatory to the electrification of the Manchester South Junction and Altrincham Railway, which was opened to traffic in 1849, was commenced within the last few days. This undertaking consists in lowering the track to the extent of about 11in. where it passes under the Chester road in the neighbourhood of Old Trafford, and is rendered necessary in order to secure the requisite clearance. The train service is, of course, being maintained although on a slightly modified scale. Invitations for tenders for the electrical equipment in connection with the scheme, which provides for overhead cables, have now been issued, and it is officially stated that the actual work of electrification will be begun within the next few weeks. According to present plans, the new system is expected to be in operation in about twelve months' time.

Cable Order Goes to Holland.

What has become almost established custom in the city when placing contracts for electric cable was followed by the Salford City Council at its February meeting, a recommendation of the Electricity Committee to accept the tender of the N. V. Nederlandsche Kabelfabriek, of Delft, for cable to the value of £9358, receiving the approval of the members of the Council. There was the usual opposition to the proposal, but it was out-voted. On behalf of the Electricity Committee it was pointed out that the difference between the Dutch tender and the tenders of the British firms was £2080.

Money for the Air Port.

The Manchester City Council has accepted a proposal of the Aerodrome Committee to apply to the Ministry of Health for permission to borrow £30,000 for the construction and equipment of the proposed municipal aerodrome at Chat Moss, Manchester.

Liverpool-Manchester Highway.

The Main Roads and Bridges Committee of the Lancashire County Council hopes to be in a position to recommend to the March meeting of the Council the acceptance of a tender for the construction of a new road between Liverpool and Manchester. This scheme has been under discussion for some considerable time. Several firms of contractors have been busy recently preparing tenders, which have to be in the hands of the committee by Friday of this week.

Loss on Coal and Iron.

In spite of the fact that in the last few years huge sums have been spent by the company on plant improvement—according to the previous year's report no less than £111,566 had been expended in this way—the directors of the Wigan Coal and Iron Company, Ltd., state in their report for the year 1928 that further capital expenditure is desirable in order to increase the efficiency of the plant and equipment and to maintain the company's competitive power. To this end the shareholders are to be asked to sanction the increase of borrowing powers. Negotiations are proceeding between the Wigan Coal and Iron Company and neighbouring concerns with a view to establishing working arrangements or to amalgamating interests. The annual report discloses a loss of £58,511 on the operations of the company for the year, compared with a loss of £7815 for 1927. The ordinary shareholders have received no dividends for four years, the last distribution being one of 4 per cent. in respect of the year 1924.

Non-ferrous Metals.

In spite of the undoubted inherent strength of the copper position, this section of the non-ferrous metals market has suffered a severe loss during the past week, the whole of the ground gained in the previous week being more than wiped out. To some extent, of course, a setback was to be expected, as a result of profit-taking, though a loss in cash metal of over £4 a ton has probably exceeded anticipations. With regard to forward positions, however, the setback amounts only to about 15s. a ton, and instead of cash copper being at a premium of over £2, as it was a week ago, forward metal quotations are now higher than cash by 10s. to 15s. at the moment of writing. Copper users continue to display a fair amount of buying interest. There has also been a moderate demand about for tin, but in this case bearish influences have been at work, and values of foreign metal, after the sharp advance recorded in this column last week, have reacted to the extent of about £3 10s. a ton, the loss in English being rather less. Prices in this section are, however, still appreciably higher than they were a fortnight ago. Active buying, coupled with indications of less plentiful supplies, has had a pronounced strenthening effect on lead, current quotations being in the neighbourhood of £1 a ton above those of a week ago. Spelter has eased off a little, particularly during the early days of this week, although prices are still above the £26 mark. There is a moderate buying movement in this section of the market.

Iron and Steel.

Although values of Midland brands of pig iron continue to display a wide variation between one county and another, there is evidence among producers of closer agreement with regard to prices. Derbyshire makers are now almost all quoting at a higher rate of 70s. 6d. per ton, delivered Manchester or equal, with offers of Staffordshire iron at up to 75s., delivered in one instance, though this is an extreme figure. The movement has spread to North-East Coast makers, who are now holding out for 80s. per ton, delivered to Lancashire users, or 1s. higher than a week ago. There is no doubt that the firmer tendency of late has stimulated buying interest, and most sellers report bigger bookings during the last week or two than for some time. This week, for the reason that users have mostly filled their needs for the time being, fresh business has fallen off, but a satisfactory feature of the situation is that deliveries against orders on the books at the blast-furnaces are being called for at a quicker rate, and this is taken to mean better conditions at the foundries. Steel buying by constructional engineers this week has not been at all active, though this may be no more than a passing lull. Lancashire boiler makers' requirements of plates are still very modest. Fair deliveries are, however, being made to locomotive building firms against existing contracts. The demand for bright-drawn bars

continues very active, and prices of these are exceptionally firm. Acid boiler plates are maintained at £9 17s. 6d. per ton; basic sorts at £9 12s. 6d.; general plates at £8 12s. 6d.; sections and joists at £7 17s. 6d.; large bars at £8 17s. 6d.; and small re-rolled bars at £8 to £8 2s. 6d. Continental iron and steel materials are attracting only a limited amount of business on this market, but prices keep up at a relatively high level.

BARROW-IN-FURNESS.

Hematite.

The fact that the Millom company has found it necessary to put another furnace in blast is reassuring from two points of view. It means, first, that stocks are down and, secondly, that the demand is not showing signs of diminishing. There may be increased production in other directions ere long, as the stocks are coming down. Everybody will welcome the clearance of stocks for obvious reasons. In better qualities of iron there is a fair business, with a tendency to improve. Continental trade is steady, but is not heavy. Business with America is in fits and starts. There was a dispatch of a cargo of pig iron last week from Barrow. A slight stiffening in prices would not surprise some people if the demand continues. The putting in of another furnace will have the effect of increasing the demand for iron ore, both local and foreign. Business has been steady, with a fair amount going out of the district. The steel trade is not very bright, but the Barrow mills are still engaged. Further contracts would be welcome in the rail departments.

Shipbuilding.

The Orient liner "Orontes" will be launched from Vickers-Armstrong's yard on Tuesday, the 26th of this month. This makes the fourth liner for this firm in the past few years. The "Orontes" will not differ much from the three previous vessels, of which the "Orama" was the first, the other two being the "Otranto" and the "Orford." Nothing is yet known of any Admiralty contracts, but some are confidently expected when the orders are given out.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

THERE has been no improvement in the condition of the heavy steel trade. Although orders are fairly plentiful, the majority are for small quantities, and competition is very keen. There has been no change in the number of open-hearth furnaces operating in the district during the last three months, and it is unlikely that there will be any such change until the demand becomes more equal to the output capacity. Consumers are not yet showing any desire to book ahead or to keep stocks of material, and so far as manufactured steel is concerned there is a noticeable absence of tonnage business. Increased business in basic steels of the lower qualities has, fortunately, more than balanced the fall in the demand for acid steels. The workshops concerned in the manufacture of axles, tires and springs for the railways are short of work, and there seems to be no indication that the British companies intend to depart from the policy of strict economy which they have pursued recently. Local and Birmingham firms have secured a contract for sixty-five carriages for the Siamese railways, but the tenders for this work were accompanied by one for 300 wagons, and this has gone to a Belgian firm.

Steel Works Reopened.

The Redbourne Hill Steel Works, North Lincolnshire, which were closed nearly four years ago, are to be reopened almost immediately, arrangements having been made for the starting of two open-hearth furnaces and the big mill. The output capacity of the mill is about 4000 tons of finished material weekly, and it is expected that it will be necessary to put further melting plant into operation to occupy it fully. A large number of men in the Scunthorpe district will be found employment as the result of the restarting of the works.

Cast Iron Research.

Reference to impending developments of an important character in cast iron production was made by Mr. J. T. Goodwin, general manager of the foundries and engineering departments of the Sheepbridge Coal and Iron Company, Ltd., when presiding at the annual dinner of the Sheffield and District Branch of the Institute of British Foundrymen. The British Cast Iron Research Association, said Mr. Goodwin, was on the verge of putting before the country and the world generally most important facts with regard to the future development of cast iron. A series of technical experiments had been carried on quietly, and they had aroused the interest of many metallurgical scientists. As Vice-chairman of the Cast Iron Research Association, he had attended a meeting in London when certain fundamental principles of cast iron were discussed. He was hopeful that an announcement would be made which would show that they were in advance of either the Continent or the world.

Nickel Silver Spoons and Forks.

The question has been raised in Sheffield whether the marking of nickel silver spoons and forks as "stainless nickel" is not misleading and unlawful, and the authorities, according to the Sheffield Chamber of Commerce, have been asked to take steps to suppress the practice. The report of the Chamber continues: "As the trade is not unanimous in the matter, it is not likely that the appeal will be granted. The metal used for such goods is nickel-silver containing a high percentage of nickel, and is of good quality. It offers considerable resistance to tarnish, but the critics assert that it is not stainless in the sense that it cannot stain or tarnish through contact with ordinary food acids. Complaints of the practice come chiefly from the makers of stainless steel spoons and forks, because the nickel goods can be sold more cheaply than their own, and they lose business owing to competition which they regard as unfair." Comments have also been made by the Chamber of Commerce on the statement that the output of stainless knives last year established a record. It is explained this may be true because of the vast quantities of cheap goods supplied to the bazaars and elsewhere. The turnover, however, was down for best qualities, and a good many firms declared that they earned no profits, if they did not actually lose money on the twelve months' trading. Some were satisfied, but they were the minority. Sheffield, it is added, is in need of a scheme of simplification to reduce the number of patterns of pen and pocket-knives. The number of patterns made in the city has been estimated at nearly 10,000, and the reluctance of many makers to act together stands in the way of reform.

Cold Working of Steel.

Some months ago a decision was announced by the Worshipful Company of Ironmongers, London, to found an Ironmongers' Company Research Fellowship and two Ironmongers' Company Research Scholarships at Sheffield University for the study of the cold working of metals, for which purpose a grant of £800 per annum for seven years was to be made to the University. This department for the cold working of steel will be ready for opening on May 14th, and advertisements are to be issued for a Research Fellow and two Research Scholars. In this matter the University has had considerable assistance from certain manufacturers through the Cutlers' Company.

Oil from Coal.

Important industrial developments are foreshadowed at Thorne Moorends, a colliery centre near Doncaster. It is understood that negotiations have been completed for the sale of 40 acres of land near the colliery of Messrs. Pease and Partners to a distillation company which owns similar works in Leicestershire. The extraction of oil from coal and possibly the manufacture of a patented fuel is expected to be among the industries introduced into the district. The site is close to the main line between Doncaster and Hull, and also to the canal. The proposal is to take coal direct from local collieries, and to distil it so as to produce crude oil and fuel. It is hoped that the erection of the works, which, it is expected, will provide employment for 100 men, will be begun in a few weeks' time.

Trade with Russia.

The announcement that a delegation representing British industrial interests has been appointed to examine the economic situation of Russia, with a view to reopening trade relations, has given considerable satisfaction in Sheffield. At the time of the expulsion of the Arcos Company from Great Britain, Sheffield was doing a considerable trade with Russia in certain classes of steel, saws, files, rasps and edge and engineers' tools, and it is estimated that trade to the value of several million pounds has been lost to the city and district. Reports to hand indicate that the Russian users of these materials are very dissatisfied with the steel and tools they have had to purchase from other sources since the Sheffield supply was stopped.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Shipbuilding Orders.

THE revival in the shipbuilding industry on the North-East Coast continues. Hawthorn, Leslie and Co., Ltd., Hebburn-on-Tyne, have this week added to their order book contracts for three more vessels. The Kave Steam Navigation Company, Ltd., London, has placed an order with the firm for a cargo steamer of about 8500 tons deadweight. The engines, of the triple-expansion type, will be supplied by the North-Eastern Marine Engineering Company, Ltd., Wallsend. The second vessel is one of about 235ft. in length, ordered by the Anglo-Saxon Company for carrying oil in casks, while the third order is for a cargo vessel of between 8000 and 9000 tons deadweight for British owners. The Furness Shipbuilding Company, Ltd., whose yard is on the river Tees, has received a repeat order for two vessels of 6400 tons each. They are to be specially designed for the gypsum trade, and are to the order of the United States Gypsum Shipping Company. Swan, Hunter and Wigham Richardson, Ltd., Wallsend, have commenced the construction of a special troopship for the Egyptian Government. The vessel, which is to be launched in August, is about 300ft. in length, and will have a speed of 15 knots. She is to be named the "King Fuad," and will cost the Egyptian Government about £100,000. The vessel will be used for carrying troops and pilgrims to and from Alexandria.

Cleveland Iron Trade.

The position in the Cleveland pig iron trade is more encouraging than for some years past. Business is expanding on a very satisfactory scale, and the general outlook is distinctly bright. Recent transactions have involved a considerable tonnage of pig iron, and confidence in further substantial home and export buying is quite marked. A rise of 1s. per ton in the prices of Cleveland iron has not caused any surprise. For a long time past ironmasters have contended that prices left no margin of profit, and were, in fact, unremunerative, but in view of the general trade conditions they have allowed quotations to remain unaltered since March last. At the moment the position is much more satisfactory. Supplies are short owing to heavy steel works consumption, and an increased call to meet the growing needs of industry. To some extent the shortage has been made up by importing Midland iron, but supplies from that area are strictly limited, and prices there are firmer. Production of basic iron has been enlarged, and there are rumours that additional furnaces are likely to be blown in shortly for the manufacture of both foundry and East Coast hematite irons. No. 1 foundry iron is 69s. 6d.; No. 3 G.M.B., 67s.; No. 4 foundry, 66s.; and No. 4 forge, 65s.

Another Blast-furnace in Operation.

Consequent upon the increased demand for basic iron, the Cargo Fleet Iron Company, Ltd., Middlesbrough, has put its third blast-furnace into operation. There are now thirty-seven blast-furnaces operating on the North-East Coast.

Hematite Pig Iron.

In the East Coast hematite pig iron trade supplies are inadequate for requirements, and stocks are almost exhausted. Weak sellers have been eliminated. Another advance of 6d. per ton is to be recorded, East Coast mixed numbers being now quoted 72s., though possibly this figure might be shaded.

Ironmaking Materials.

The foreign ore trade is quiet, but prices are firmly based on best Rubio at 22s. 6d. per ton, c.i.f. Tees, and there is not much prospect of contracts being renewed on better terms. There is increasing strength in the coke market, and 18s. per ton is quite a minimum price for good average blast-furnace coke delivered at North-East Coast works.

Manufactured Iron and Steel.

Active conditions still prevail in the manufactured iron and steel trade, and outputs are on the increase. Producers are booking orders freely for constructional steel and shipbuilding requisites, and business in other sections is brisk. Prices are unchanged, except that iron rivets are advanced 5s. to £11 10s. per ton.

The Coal Trade.

One of the most gratifying features of the Northern coal trade at the moment is the element of sustained strength in the demand. The briskness may continue throughout the year. This implies a world-wide recovery in the consumption of coal, both for direct industrial purposes and by processes for the recovery of residuals. The seasonal special needs will pass away at the end of the first quarter of the year, but another form of demand is already beginning to take its place. There are inquirers who are willing to buy gas coals at present prices for April and May shipment, and doubtless over the year business could be negotiated at fairly good figures. There is not the same probability of steams being bought ahead on the basis of the present high values, but it is not unlikely that prices will keep to a very strong level, as the demand is in such large and sustained volume and so widespread. An epidemic of influenza among miners, particularly at Durham pits, is seriously affecting production. At one colliery about 200 hewers were off work at the beginning of the week. Other pits are affected, but not to the same extent. Northumberland steam coals, under heavy bookings and sustained forward inquiry, are firmly quoted at 15s. 9d. to 16s., and seconds at 14s. 6d. to 15s. Tyne primes share in the generally improved position, and a minimum of 15s. for large and 10s. for smalls is quoted, though through second-hand holders small concessions can be obtained. The Durham gas coal trade is steady, and supplies are becoming scarce. Best qualities are quoted at 14s. 9d. to 15s., and seconds at 13s. 9d. to 14s. 3d. The bunker coal position is firm. Best and superiors command from 14s. 6d. to 15s. 6d. and ordinary kinds from 14s. to 14s. 6d. There is an improving tone in the coke market. The demand is slowly expanding and prices are just a turn harder. Gas coke is 18s. 6d.; patent oven cokes, 18s. 6d. to 19s. 6d.; and beehive and special cokes, 23s. 6d. to 28s. 6d.

Tees Wharf Scheme.

Dorman, Long and Co., Ltd., the Teesside firm of iron and steel manufacturers, are negotiating with a view to acquiring additional river frontage on the Tees. The negotiations concern the wharf belonging to Connal and Co., and the extensive land behind the wharf, which will make the total river frontage available for shipping purposes for Dorman Long's something like three-quarters of a mile. With the exception of the Ayresome Wharf, belonging to Gjers, Mills and Co., the purchase would give Messrs. Dorman Long the whole of the river frontage on the south side of the Tees from Acklam Corner to the Newport High Wharf.

SCOTLAND.

(From our own Correspondent.)

Labour Affairs.

THERE are hopes of an early settlement of the trouble in the wrought iron industry over the question of the number of hours to be worked per week. Meanwhile one or two of the works remain in operation. Moulders engaged in the production of rain-water goods in the light castings industry are again in action, the majority having agreed to an immediate reduction of 2½ per cent., and a further drop of 2½ per cent. in wages on April 1st. Wages will thereafter be stabilised for the remainder of the year. It is anticipated that the dispute in the mining industry over the proposed reduction in the wages of enginemen will be settled immediately. The coalowners propose a reduction in wages of 8d. per shift. The men strongly oppose the reduction, on the assumption that when in 1920 an increase of 1s. 8d. was granted, that amount was added to the standard rate of wages. The men are, however, willing to submit to arbitration on the question.

Steel.

Makers of heavy steel are in a comparatively good position at present, and more especially those engaged

in the production of shipbuilding materials, the demand for which shows considerable improvement. Costs of production have risen somewhat, however, owing to higher prices of pig iron and scrap. Sheet makers, also, are faced with increased costs of raw materials owing to the rapid advance in the prices of continental steel bars, and the consequent higher quotations for sheets may have an adverse effect on business. Heavy steel scrap is quoted at 68s. 9d. per ton.

Iron.

With the majority of the bar iron works still affected by the dispute on the question of the length of the working day, those establishments still carrying on find themselves busier than they have been for a long time back. The demand for re-rolled steel has declined a little, but quotations are still firm at £7 15s. per ton home and £7 10s. to £7 15s. per ton export delivery. The twenty-one blast-furnaces in operation are more than capable of meeting all present demands for pig iron.

Manufactured Copper Dearer.

Within the past few weeks manufactured copper has been advanced on two occasions by £2 per ton, and the current quotation is now £108 per ton basis. The price of yellow metal condenser plates is ¼d. per pound dearer at 10d. per pound for ordinary rectangular plates.

Exports and Imports.

During the past week 10,000 tons of iron ore, 2500 tons of steel and iron, and 700 tons of pig iron were unloaded at Glasgow Harbour. Shipments of steel and iron amounted to 3800 tons, and of pig iron to 468 tons.

Advance in Scrap.

Cast iron scrap has been advanced in price, and is now quoted £3 7s. 6d. per ton.

Coal.

Developments in the coal trade have been on recent lines. Home demands continued to increase and absorbed the greater part of the output, leaving very little fuel available for export. In all districts the collieries in action are booked ahead for some weeks, and for any small lots becoming available for disposal very firm prices are quoted. The possibility of trouble in Poland has already had the effect of increasing the inquiry from abroad, and while the position of the collieries may be strengthened thereby, they are not in a position meantime to take any advantage unless, as it may be assumed, in the event of trouble materialising abroad, additional pits were reopened. Meanwhile shippers could not possibly obtain prompt supplies. All descriptions of large and small coals are scarce, and prices quoted are approximate, the market being nominal. Aggregate shipments amounted to 256,385 tons against 220,912 tons in the preceding week, and 254,419 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

SHIPMENTS of coal from this district last week scarcely came up to expectations, and, in fact, were slightly disappointing, but the fact is that tonnage fell off somewhat during the second half of the week. However, arrivals over the week-end were fairly substantial, as on Monday there were eleven steamers waiting to get into berth, while there were only six idle tipping appliances. On Tuesday the number of waiting steamers was increased to nineteen, while the number of idle appliances was eight. It is interesting to note that, of the total number of steamers waiting, seventeen were at Cardiff, Penarth and Barry, so that the position of collieries shipping steam coals at those docks is fairly secure. Unfortunately, the heavy blizzard which prevailed on Monday disorganised the conditions generally, inasmuch as coal-loading operations were very much retarded, and work on the docks was interfered with. In the coalfields, work was also adversely affected, as in a number of districts miners were unable to get to their work. The result is that shipments this week will suffer to some extent and tonnage will be delayed. The conditions, however, are improving, and, at any rate, they are by no means as bad as are being experienced on the Continent, where, owing to the wintry weather, the movement and shipment of coals are so seriously affected that a better demand is being experienced for coals from this country, and a number of steamers which would under other conditions have been fixed for loading at Rotterdam and other ports are now seeking employment from this district and from the North-East Coast. The cold snap has, of course, sharpened the demand for coals for inland purposes, but apart from that, there appears to have been a fair amount of business done of late for export. Reports are current of several contracts for about 50,000 tons of steam coals having been entered into for shipment over the next three and six months. The Egyptian State Railways, which recently bought 200,000 metric tons of Welsh coal for delivery over the next three months, have intimated that they will be seeking tenders for 180,000 metric tons of large coal, and that the adjudication will take place on April 16th. It is assumed that the delivery of these coals will be from about May to August next. Among other inquiries on the market is one from the Portuguese State Railways for about 120,000 tons of Welsh coals, presumably for delivery over a period of about six months. In all the circumstances, the outlook is fairly favourable. The report was current that a coal strike was imminent in the Polish coalfields, but so far there is no definite information forthcoming. The position is being very closely watched, as developments of this description would have a beneficial effect upon the demand for coals from this country.

Increasing Coal Production.

There is no doubt that in a number of cases collieries are finding it difficult to keep pace with their commitments, owing to the improved demand, yet at the same time there is always the feeling that while the conditions are better there is the prospect of the reopening of collieries bringing about a change in the situation and over-production resulting. From the point of view of relieving the unemployment problem, it is a welcome development. During the past week reports have been received of the reopening of several pits in this district, while as regards the position at Nine Mile Point Colliery, where last week there was a certain amount of rioting, negotiations are taking place between the Federation officials and the company, and strong hopes are entertained of a settlement being come to.

LATER.

The dispute between the owners of the Nine Mile Point Colliery and the Miners' Federation was settled at Cardiff on Wednesday, subject to ratification by the workmen. The terms of settlement include one that provides that workmen are to be reinstated in their old positions.

Trade Development.

While the Cardiff Corporation has decided to scrap its development department, the Newport Development Association reports that it has been successful in inducing the Bristol Steam Navigation Company to place steamers upon the Newport berth for Rotterdam. The Association has for some time been endeavouring to secure regular sailings to the Dutch port. Quite a large business is done in tin-plates, &c., from the Newport district, but hitherto the traffic has been going to Bristol, on account of the irregularity of the sailings from Newport. It is hoped that this difficulty has now been overcome.

New G.W.R. Bill.

The Cardiff Chamber of Commerce has decided to present a petition to the House of Commons against the Great Western Railway Bill of this session in which powers are sought to continue for a further period of five years from October 1st, 1929, the increased charges over the statutory maximum. The coalowners and Coal Freighters' Association are also opposing the company.

New Tin-plate Works.

It is reported that plans have been completed for the erection of four new tin-plate mills at the works of the Baglan Bay Tin-plate Works at Briton Ferry.

Subsistence Wage.

At a special meeting of the South Wales Coal Conciliation Board on Monday the question was raised as to the conditions governing the payment of the subsistence wage to the lower-paid men in the coalfield. The representatives of the owners suggested that both parties should approach the independent chairman and ask for his interpretation of the clause in his award. The workmen's representatives intimated that they would consider the matter, and give their reply before the next meeting of the Board, to be held in a fortnight's time.

Current Business.

The general tone of the coal market keeps very firm for prompt loading. As a matter of fact, very few collieries indeed have any coal to offer for shipment this month, and the only sales taking place are for very small parcels for which top current figures are obtainable. The outlook for the coal trade up to the end of March is fairly bright, inasmuch as the majority of collieries have orders on their books which mean that they are in a comparatively comfortable position for a month or so ahead. Provided tonnage keeps up to requirements, the conditions are likely to remain fairly busy, though it would be more satisfactory for the collieries if the prices obtained for their coals were on an economic basis. This desirable end has not as yet been achieved, though it is something to say that collieries are not making the enormous losses as was formerly the case. Patent fuel works are also busier and coke is a firm market. Pitwood is steadier at 26s. 6d. to 27s.

LAUNCHES AND TRIAL TRIPS.

VAN DER LIJN, passenger and cargo steamer; built by the Netherland Shipbuilding Company, to the order of the Koninklyke Paketvaart Maatschappij; dimensions, 290ft. by 43ft. by 21ft. 3in.; constructed by Werkspoor; trial trip, 1st.

RALPH GILCHRIST, steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Mr. J. J. Boland and Captain R. Scott Misener, Canada; dimensions, 253ft. by 43ft. 4in. by 20ft.; to carry about 2585 tons. Engines, triple-expansion, pressure 180 lb.; constructed by the builders; launch, February 9th.

WARDEN, steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of the Corporation of Trinity House, London; dimensions, 172ft. 6in. by 31ft. 6in. by 15ft. 6in. Engines, twin sets of triple-expansion; constructed by the builders; launch, February 12th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

SULZER BROTHERS, of Winterthur, ask us to announce that the telephone number of their London office—31, Bedford-square, W.C. 1—has been changed from Museum 4843 and 4845 to Museum 0702 (4 lines).

MR. EDWARD T. ELBOURNE asks us to announce that he has removed his offices from 8, Great St. Helens, E.C. 3, to Equitable House, 47/51, King William-street, London, E.C. 4. Telephone Central 1281. Telegrams Elbourne, Cannon, London.

UNDERWOOD TYPEWRITER COMPANY, Ltd., asks us to announce that it has decided to establish its head sales office with its associated company, the General Office Equipment Corporation, as and from February 11th, the offices of which are at Bush House, Aldwych, London, W.C. 2, to which it is requested that all communications intended for the sales departments should be addressed.

CONTRACTS.

THE "DE MAAS" SHIPBUILDING COMPANY, of Slikkerveer, Holland, has received an order from the Royal Packet Company of Amsterdam to build two passenger and cargo steamers 252ft. long by 40ft. beam and 15ft. 6in. depth.

STANDARD TELEPHONES AND CABLES, Ltd., of Columbia House, Aldwych, London, W.C. 2, has received from the Post Office an order for a main automatic telephone exchange at Newcastle-on-Tyne, and eleven satellite or sub-exchanges providing in all nearly 20,000 lines, with an ultimate capacity of 42,000. The exchanges will be equipped with step-by-step apparatus, and it is expected that they will be completed by the end of 1930.

JOHN THOMPSON WATER TUBE BOILERS, Ltd., of London and Wolverhampton, have received by cable an order from the State Electricity Commission of Victoria, Melbourne, Australia, for boiler-house equipment for the Yallourn power station. The order, which is of the value of £223,288, is for eight boilers, each having an overload capacity of 85,000 lb. of steam per hour, 275 lb. working pressure, complete with superheaters to give a final temperature of 700 deg. Fah., air preheaters, forced and induced draught fans, steel casings, fire-brick linings, and pipe work.

CATALOGUES.

A. B. CLEWORTH AND CO., Ltd., 150, Queen Victoria-street, E.C. 4.—Catalogue describing in detail the "Karrena" flat suspended furnace roof.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, E.C. 4.—Catalogue No. 1075, on mechanical draught and cinder elimination.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria-street, S.W. 1.—Brochure No. 50E, dealing in detail with La Cour motor converters.

JAMES KEITH AND BLACKMAN COMPANY, Ltd., 27, Farringdon-avenue, E.C. 4.—Publications G. 133 on the "Keith" thermostat gas controller and 121 on K-B steel tube air heaters.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., 82, York-road, King's Cross, N. 1.—A brochure dealing with the Westinghouse system of heating trains by steam at atmospheric pressure.

ALLEY AND MACLELLAN, Ltd., Sentinel Valve Works, Worcester.—Oil Valve Catalogue No. 1, comprising over 100 pages, illustrating and giving full particulars of all types of "Sentinel" oil valves for all purposes.

CHEMICAL ENGINEERING.—A paper on "Chemical Engineering" was read before the Manchester Association of Engineers on Friday last, by Mr. C. E. S. Place. The author subdivided his subject into several sections as follows:—General plant, which included steam and electrical appliances, water service, handling plant, and refrigeration machinery; the storage and treatment of acids; hydro-extractors; autoclaves; machines for grinding, sieving, and mixing materials, and the construction of wooden vessels. On the subject of steam supply, Mr. Place mentioned that steam was used in large quantities, and in nearly every case was supplied for works purposes or for process service at low pressures. Consequently where steam was not required for generating electricity the Lancashire boiler presented the best means of steam generation. In connection with electric power supply, the author stated that there were conditions in chemical works which did not generally apply to other factories. The alternating-current type motor was almost universally used, as, independent of its purely electrical advantages, it was a safeguard against fire, where highly inflammable materials were being manufactured. Switchgear presented trouble on account of insulation difficulties.

A COMMEMORATIVE ALBUM.—In order to mark the twenty-fifth anniversary of the foundation of their firm, Messrs. Christiani and Nielsen have published an illustrated album, to which the title of "Twenty-five Years of Civil Engineering" has been applied. The album contains descriptions—contributed, for the most part, by the firm's own engineers, though some are by independent engineers and scientists with whom Messrs. Christiani and Nielsen have collaborated—of numerous reinforced concrete works carried out in different parts of the world. The articles, which are written in excellent English and are profusely illustrated, deal, among other things, with aeroplane hangars; barrages and locks; breakwaters; bridges; buildings of various kinds; cold stores; grandstands; heating systems; industrial works; jetties and wharves; power plants; railway stations; sewers; silos; a train ferry berth, &c. There are also articles dealing with various scientific problems connected with reinforced concrete work. The whole forms a book which is eminently readable and highly interesting. In the introduction it is pointed out that the firm, with headquarters at Copenhagen, comprises fully organised, more or less independent but closely collaborating, affiliated companies in twelve different countries.

INSTITUTION OF CIVIL ENGINEERS.—The annual dinner of the Manchester and District Association of the Institution of Civil Engineers was held at the Midland Hotel, Manchester, on Wednesday, February 6th. Mr. S. H. Morgan, M.C., M. Inst. C.E., chairman of the Association, presided, and there was a good attendance of members and visitors, including Sir Brodie Henderson, K.C.M.G., President of the Institution, the Lord Mayor of Manchester, and the chairmen of kindred societies. In response to the toast of the Institution, proposed in a very neat speech by Mr. R. S. Bamber, B.Sc., a student of the Institution, Sir Brodie Henderson, after mentioning that he received his early training at Manchester University, confined his remarks chiefly to the work of the Institution, which, he said, was "going strong" and performing work of immeasurable value to this and other countries. He said there were now eight local associations of the Institution, including one at Buenos Aires, and that the work of the Council was divided up amongst twelve committees and six special committees, while the members of the Council were chosen from all the different branches of engineering. Addressing his remarks chiefly to the younger section of his audience, the President said that the examinations were becoming more and more difficult, and that to qualify for corporate membership in addition to passing examinations, practical experience, work and imagination were required. The President also called attention to the library of the Institution, which, he said, was the finest of the kind in the world, and the contents were always at the command of the members. The Lord Mayor of Manchester, Councillor Lieut.-Colonel G. Westcott, in proposing the toast of "The Manchester and District Association," as an architect appealed to the civil engineer for more co-operation between the two professions in the design and construction of large buildings. In his reply, the chairman said that civil engineers were too prone to self effacement. They should educate the public more as to the great work which they were doing. With regard to road construction and its importance, he said that the subject was now recognised by London University, which had established a Chair of Highway Engineering. The toast of "The Guests" was proposed by Mr. W. G. McCracken, associate member, and was responded to in characteristically humorous vein by Mr. B. Mouat Jones, D.S.O., M.A., principal of the Manchester College of Technology.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	17/6 to 19/-
(1) Spanish	21/-
(1) N. African	21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 15 0	—
No. 1 Foundry	3 13 6	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 12 0	3 12 0
No. 1	3 12 6	3 12 6
Cleveland—		
No. 1	3 9 6	3 9 6
Silicious Iron	3 9 6	3 9 6
No. 3 G.M.B.	3 7 0	3 7 0
No. 4 Foundry	3 6 0	3 6 0
No. 4 Forge	3 5 6	3 5 6
Mottled	3 5 0	3 5 0
White	3 5 0	3 5 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 5 0	—
(3) Northampton—		
Foundry No. 3	2 17 6	—
Forge	2 12 6	—
(3) Derbyshire—		
No. 3 Foundry	3 2 6	—
Forge	2 17 0 to 2 18 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 1 0	—
No. 4 Forge	2 17 6	—
Basic	3 1 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 0 0 (*a*); 4 3 6 (*b*); 4 6 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 10 0 to 8 17 6	—
Gas Tube Strip	10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal. Cor. 24 B.G.)	13 10 0	13 12 6 to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 15 0	—
Soft Billets	6 15 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	8 0 0 to 8 2 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 12 6 to 9 17 6	—
Sheffield—		
Siemens Acid Billets	8 15 0 to 9 0 0	—
Hard Basic	8 15 0	—
Intermediate Basic	7 5 0 to 7 15 0	—
Soft Basic	6 17 6 to 7 0 0	—
Hoops	9 5 0 to 9 10 0	—
Soft Wire Rods	7 15 0 to 7 17 6	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 2 6 to 6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 12 6 to 13 15 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	9 15 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/3
Block Tin (cash)	224 15 0
,, ,, (three months)	225 5 0
Copper (cash)	76 8 9
,, (three months)	77 0 0
Spanish Lead (cash)	23 6 3
,, ,, (three months)	23 5 0
Spelter (cash)	26 2 6
,, (three months)	26 6 3
Manchester—	
Copper, Best Selected Ingots	83 0 0
,, Electrolytic	84 15 0
,, Strong Sheets	108 0 0
,, Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
,, Condenser, lb.	0 1 3
Lead, English	24 15 0
,, Foreign	23 0 0
Spelter	26 7 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/6½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 15 0	7/6
,, ,, 6 p.c. to 8 p.c.	£20 12 6	7/-
,, ,, 8 p.c. to 10 p.c.	£20 10 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/-
,, ,, ,, 1 p.c. carbon	£37 0 0	15/-
,, ,, ,, 0·70 p.c. carbon	£44 0 0	17/-
,, ,, ,, carbon free	1/- per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/- per unit	
,, Vanadium	14/- per lb.	
,, Molybdenum	3/9 per lb.	
,, Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	15/-
,, ,, Ell	18/-
,, ,, Splint	17/- to 18/6
,, ,, Trebles	15/6 to 16/-
,, ,, Doubles	15/6
,, ,, Singles	13/6
Ayrshire—	
(f.o.b. Ports)—Steam	16/-
,, ,, Jewel	18/-
,, ,, Trebles	17/-
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	16/- to 17/6
Screened Navigation	18/-
Trebles	17/- to 17/6
Doubles	16/- to 16/6
Singles	14/6
Lothians—	
(f.o.b. Leith)—Best Steam	16/-
Secondary Steam	15/-
Trebles	16/6
Doubles	16/-
Singles	14/3

ENGLAND.

(8) N.W. Coast—	
Steams	23/-
Household	38/6 to 51/-
Coke	22/-
Northumberland—	
Best Steams	16/-
Second Steams	15/-
Steam Smalls	10/-
Unscreened	13/-
Household	21/- to 27/-
Durham—	
Best Gas	15/-
Second	14/3 to 14/6
Household	21/- to 27/-
Foundry Coke	19/6 to 20/-
Sheffield—	Inland.
Best Hand-picked Branch	26/- to 27/6 —
Derbyshire Best Bright House	22/6 to 24/- —
Best House Coal	20/6 to 21/6 —
Screened House Coal	17/- to 18/- —
,, ,, Nuts	16/- to 18/- —
Yorkshire Hards	15/- to 16/- —
Derbyshire Hards	15/- to 16/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	4/6 to 6/- —
Smalls	3/6 to 4/- —
Blast-furnace Coke (Inland)	14/6 at ovens —
Furnace and Foundry Coke (Export), f.o.b.	19/- to 19/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	19/- to 19/3
Best Dry Large	18/6 to 19/-
Ordinary Dry Large	18/- to 18/6
Best Black Vein Large	18/9 to 19/3
Western Valley Large	18/6 to 19/-
Best Eastern Valley Large	17/6 to 18/3
Ordinary Eastern Valley Large	17/- to 17/6
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/- to 13/-
Washed Nuts	18/- to 24/-
No. 3 Rhondda Large	20/6 to 21/6
,, ,, Smalls	14/6 to 15/-
No. 2 ,, Large	17/6 to 18/-
,, ,, Through	16/- to 17/-
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	27/- to 37/-
Furnace Coke (export)	19/- to 21/-
Patent Fuel	20/- to 21/6
Pitwood (ex ship)	26/3 to 26/9
Swansea—	
Anthracite Coals :	
Best Big Vein Large	33/- to 35/-
Seconds	25/- to 29/-
Red Vein	22/- to 27/-
Machine-made Cobbles	40/- to 43/6
Nuts	36/- to 43/6
Beans	23/6 to 25/-
Peas	16/6 to 17/6
Breaker Duff	9/- to 9/6
Rubbly Culm	9/6 to 10/-
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	9/6 to 12/-
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated.

coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield.

(*c*) Delivered Birmingham. (*d*) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Rail Union.

As the International Rail Union is due to expire at the end of March a committee is engaged in the preparation of a revised agreement which will allow of its being renewed. It is quite clear that a continuance of the present conditions will not be accepted by continental makers, who insist upon some arrangement being come to whereby British firms will be deprived of their monopoly of the trade in the Colonies and Dominions, as well as in certain other markets in which the railways are largely controlled by British capital. In such cases there is naturally a tendency to specify British rails. Makers in Great Britain have so considerably exceeded their quota as to be involved in heavy penalties which, however, cannot be exacted by the Union so long as it remains in existence, and it is this curious clause that the continental makers wish to delete, while they desire, at the same time, to increase the penalty for any excess above the quota to £1 per ton. British makers accept the principle of a penalty, but they claim at least partial exemption in cases beyond their control, such as buyers' specifications for British rails, and they object to the proposed increased penalty. So far the Rail Union has worked well, and it is feared that if its operations were to cease, there would be reckless price cutting, which might affect British makers more than the continental.

Sewage Disposal.

The proposal of the Paris Municipality to extend the sewage farm at Achères along the Seine Valley in order to deal with an additional 115,000 cubic metres of sewage a day is being pushed forward with so much insistence, despite the uncompromising local opposition, that it has been found necessary to introduce a Bill into the Senate to prohibit the discharge of sewage on farms altogether. The Bill is supported by exceptionally strong medical testimony regarding the dangers of this method of sewage disposal, not only to inhabitants in the vicinity of the farms, but also to people who consume produce grown on them. Statistics are given showing the prevalence of typhoid fever in such cases, and it is declared that modern bacteriology and a more complete knowledge of the physiology of plants have entirely disproved the claims of those who formerly regarded the sewage farms as offering all kinds of advantages. The new Bill therefore provides that there shall be no more sewage farms in France, and that those already existing will have to be suppressed within a period of fifteen years.

Railways.

The Commission of Public Works in the Chamber of Deputies recently asked the Minister of Public Works to explain certain matters affecting the railways, and from the information supplied, it appears that the railway companies are not in favour of adopting the Rodolausse automatic device for stopping locomotives when signals are against them, notwithstanding that the trials carried out with the apparatus on the Orleans Railway are reported to have given quite satisfactory results. The companies fear that an automatic arrangement of this kind will have the effect of rendering locomotive drivers careless of signals, and they furthermore point to technical difficulties in the way of a general adoption of the system. The Commission appeared to think that there was some prejudice in this attitude, and the Minister was asked to bring the matter before the companies again. In the same way the companies could not entertain the idea of adopting automatic couplings, mainly on account of the cost. Reference was also made to the resumption of work upon new lines which had been temporarily abandoned. The Minister declared that some, at least, of those lines could be replaced by road motor car services.

Paris Electrical Supply.

The accident which occurred at Saint-Ouen when the 12,000-volt mains leading out of the power station there were destroyed by fire, and the greater part of Paris was left in darkness, has shown the inconvenience of the present system of electrical distribution. There is as yet no satisfactory explanation of how the mains could have been overloaded to the extent of causing the fire. The distribution is in the hands of the Compagnie Parisienne de Distribution d'Electricité, which is under the control of the Paris Municipality. There are two power stations, one at Saint-Ouen and the other at Issy-les-Moulineaux, but while the latter distributes current at 50 periods, the Saint-Ouen Station operates at 42 periods, so that, on the supply failing, no assistance could be obtained from Issy-les-Moulineaux. Arrangements are now being made to supplement the supply from the Dordogne, where the Coindre hydro-electric power station has just been put into service by the Orleans Railway Company. The Coindre power station is connected up with the more powerful Eguzon hydro-electric plant, and the current not required for the railway will be sent to Paris. At Chevilly the current will be transformed from 90,000 volts to 60,000 volts, and in Paris two stations have been installed at Tolbiac and the Nation for transforming the current to 12,000 volts. In October next these two stations will be supplying 25,000 kW, which will be increased later on to 50,000 kW. This is a small contribution to a total which, in winter, exceeds 300,000 kW, but plans have been prepared for bringing to Paris, at some future date, a considerable quantity of energy from other hydro-electric stations in the south of France.

Steel Prices.

Iron and steel prices have advanced 2f. per 100 kilos. for merchant bars, girders, hoops and rods, and from 3f. to 4f. for sheets. Merchant bars are now 93f. per 100 kilos. and girders 91f. This advance has been retarded as long as possible, and it is believed that a period of higher prices will inevitably follow upon the increasing industrial activity and the additional charges that are to be imposed upon industry by the new social legislation which will come into operation shortly.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

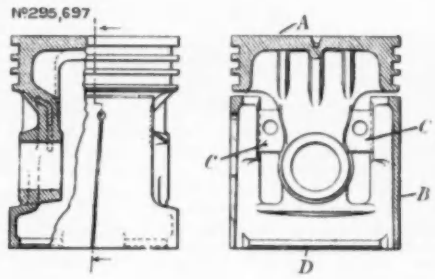
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

295,697. October 10th, 1927.—PISTONS, A. L. Nelson, 3780 Hazlewood-avenue, Detroit, Michigan.

The object of this invention is to provide a piston of a light alloy, such as one of aluminium, which has a free skirt and yet is reasonably rigid. The head of the piston A is connected with

Nº295,697

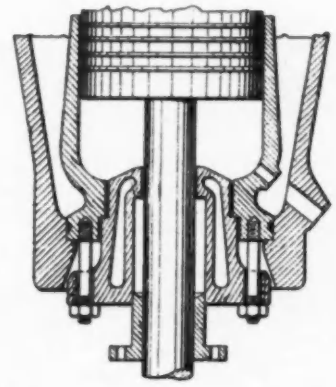


the skirt B by means of the gudgeon pin bushing and by the chaplets C C, which are of steel or some other metal which has a lesser thermal coefficient of expansion than aluminium. The bottom of the skirt is reinforced by means of two arc-shaped flanges D.—*January 10th*, 1929.

300,542. June 19th, 1928.—CYLINDERS OF DOUBLE-ACTING ENGINES, G. Ferguson, 260, Rennweg, Wülflingen, Switzerland.

In effect this invention amounts to the substitution of the normal bottom cylinder cover of an engine by a plug of a com-

Nº 300,542



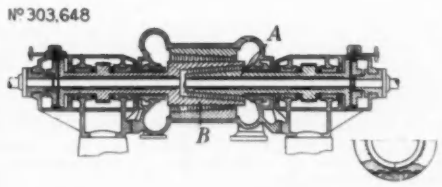
paratively small diameter, while the bore of the cylinder is correspondingly reduced at the bottom. In this way the cylinder cover bolts are relieved of some of the stress they would otherwise be subjected to. The plug, it will be seen, is appropriately water cooled.—*January 10th*, 1929.

TURBINE MACHINERY.

303,648. January 4th, 1928.—HIGH-PRESSURE STEAM TURBINES, K. Roder, 3, Alleestrasse, Hanover, Germany.

It appears that this steam turbine would be of the axial flow reaction type with two rotors A and B turning in opposite direc-

Nº 303,648



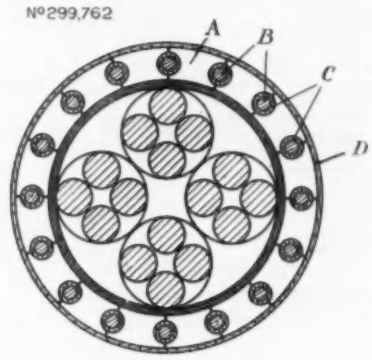
tions. Both these rotors would be overhung from their bearings and steam would be admitted through their hollow shafts. Precautions, it is suggested, should be taken for the minimising of heat transfer between the inlet pipes and the bladed parts of the machine.—*January 10th*, 1929.

TELEGRAPHS AND TELEPHONES.

299,762. May 14th, 1928.—SUBMARINE CABLES, Felten and Guilleaume Carlswerk Actien-Gesellschaft, of Köln-Mulheim, Germany.

This invention relates to a cable with a pressure protection made of light metal profile wires and steel wires. The formation of gaps between the steel and light metal wires is avoided, and the steel wires are pressed round by a lead covering. The pressure which exists in the case of comparatively deep seas causes the lead surrounding the steel wires to be pressed into the gaps, thereby closing up the cable in a water-tight manner. The drawing illustrates by way of example a form of construction of the invention as applied to a deep-sea telephone cable containing four quads. Light metal wires A of the pressure protection have a trapezoidal cross section, and are recessed for the reception of the steel wires B. The steel wires are surrounded by lead coverings C. Over the pressure protection there

Nº299,762



is a thin layer D of a material impermeable to water, for instance, gutta-percha.—*January 3rd*, 1929.

MEASURING AND TESTING INSTRUMENTS.

292,101. June 6th, 1928.—INDICATING INSTRUMENTS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2.*

When a large number of measuring instruments is mounted upon a switchboard it is not always feasible to have them all situated at the level of the eye or in positions of maximum visibility. Some portion of the scale of an edgewise instrument equipped with the ordinary glass window and mounted in the usual way is very apt to be blurred or invisible when viewed from certain positions because of glare. This difficulty is overcome by employing a transparent window, such as glass or celluloid, the outer surface of which has been slightly roughened as indicated, or treated in some way to prevent glare, and arranging the window in close proximity to the pointer and scale. A glass

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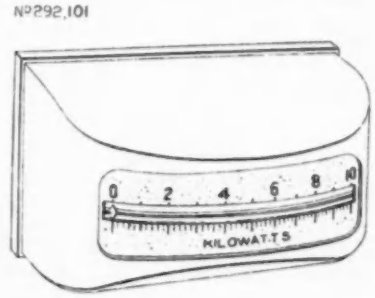


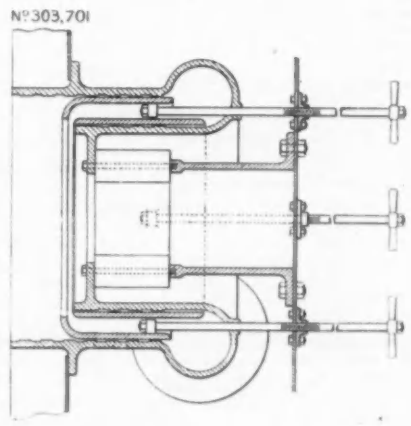
or other transparent window, having an outer surface which has been treated in some way such as by a light sand blasting or chemical treatment so as to remove or destroy the smooth surface and thus prevent glare, is employed. The result of such treatment very materially reduces the visibility of the pointer and scale unless the pointer and scale are placed in close proximity to the window. To overcome this difficulty, several precautions all of which are helpful, may be taken; first, the sand blast or other polish removing operation is made very light; and secondly, the window is made as thin as practicable. This reduces the distance between the outer surface and the scale and has the same effect as moving the scale nearer the window; and thirdly, the pointer and scale are brought into close proximity to the window.—*December 27th*, 1928.

FURNACES.

303,701. April 4th, 1928.—PULVERISED FUEL BURNERS, H. E. Yarrow, Scotstoun, Glasgow.

This invention relates to pulverised fuel burners of the kind in which the pulverised fuel and its conveying air are given a whirling motion by injecting them tangentially into an annular chamber from which they issue through an annular opening of variable width to mingle at the entrance to the furnace with the main air supply, to which also a whirling motion is imparted by an arrangement of guide vanes. The annular chamber traversed

Nº303,701



by the pulverised fuel and its conveying air on their passage to the annular opening into the furnace has both of its walls longitudinally adjustable, with the object of making it possible, not only to vary the area or width of the annular fuel orifice, but also to vary its position longitudinally with respect to the discharge orifice of the main air supply, and also the angle at which the fuel mixture enters the furnace. The enumeration of the objects aimed at in the invention is sufficient to explain the construction of the apparatus shown in the drawing.—*January 10th*, 1929.

LOCOMOTIVES.

303,284. January 17th, 1928.—WATER-TUBE LOCOMOTIVE BOILERS, H. E. Yarrow, Scotstoun, Glasgow, and H. N. Gresley.

In this specification claim is made for a locomotive water-tube boiler, "wherein the furnace gases, after passing over the

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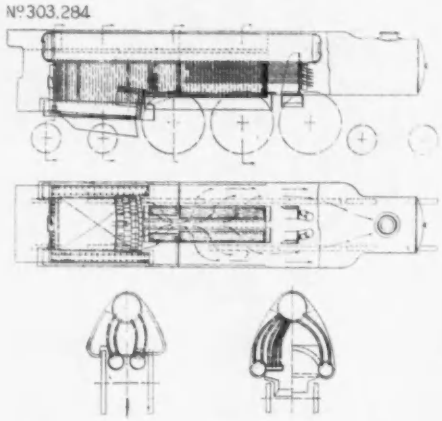

usual fire-brick arch, enter a secondary combustion space, and pass thence into a central flue between the forward banks of water tubes and thence transversely amongst these water tubes to parallel outer flues leading to the smoke-box." The disposition of the tubes is clearly indicated in the drawings.—*January 3rd*, 1929.

MINING MACHINERY.

303,326. May 25th, 1928.—TELESCOPIC PIT PROPS, A. C. Marshall and A. S. Priest, Imperial House, 80, Regent-street, London, W. 1.

This prop is made of two parts, the lower one A of which telescopes within the upper half B. The upper piece is cut away at the bottom, as shown in the small sketch. A hinged clamp C is attached to the part D, and can be tightened by a bolt E, so

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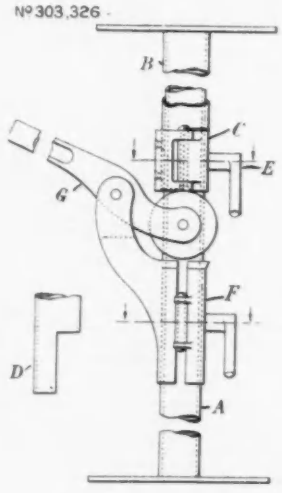

as to grip the two telescoping parts together. Another clamp F is gripped on to the lower part of the prop, and carries a bifurcated lever G, which can be used to extend the upper part by bearing underneath the clamp C. The clamp C is, of course, loosened during extension, and is then tightened to make the prop rigid. The lower clamp and lever can be removed for use elsewhere.—*January 3rd*, 1929.

MACHINE TOOLS AND SHOP APPLIANCES.

303,340. July 27th, 1928.—FORGING METALS, L. Renault, 8–10, Avenue Emile Zola, Billancourt (Seine), France.

This machine is intended for the upsetting of bars for such purposes as the manufacture of bolt heads or the valves for internal combustion engines. The bar A is heated in contact with the die B by electrical means, and is pushed forward, to effect the upsetting, by the screw C. It is suggested that the heating

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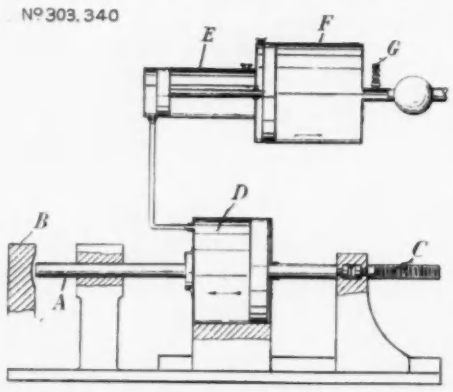

may occasionally be ineffective, so a hydraulic buffer D is interposed between the screw and the workpiece. This buffer is kept under a definite pressure by the intensifier E, which is loaded by air pressure in the cylinder F. In the event of the workpiece being too cold to flow, in upsetting, the buffer yields, although the screw continues to press forward, until the proper heat has been resumed. The relief valve G settles the pressure at which the buffer yields.—*January 3rd*, 1929

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INDUSTRIAL WELFARE SOCIETY (INCORPORATED).—Hotel Victoria (Edward VII. Rooms), Northumberland-avenue A Conference on Industrial Canteen Management. 10.15 a.m.

INSTITUTION OF ENGINEERS-IN-CHARGE.—Visit to the Leathersellers' Hall, St. Helen's-place, Bishopsgate, London, E.C. 2. 3 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Annual general meeting. Paper, "Refrigeration on Shipboard," by Mr. H. J. Ward. 6 p.m.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS.—Surveyors' Institution, 12, Great George-street, London, S.W. 1. Lecture, "Salvaging the Fleet at Scapa Flow," by Mr. G. Atkinson. 5.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "Steam Storage," by Mr. E. G. Ritchie. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Chemi-Luminescence," by Dr. E. K. Rideal. 9 p.m.

WEST BROMWICH ENGINEERING SOCIETY.—Kenrick Technical College, West Bromwich. Address, "A Business Man's World Tour," by Mr. W. W. Hackett. 7.30 p.m.

SATURDAY, FEBRUARY 16TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, JUNIOR SECTION.—College of Technology, Sackville-street, Manchester. Paper, "The Story of Iron Throughout the Ages," by Mr. E. Garside. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the Post Office (London) Railway.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Beverley, Yorks. Yorkshire District meeting. 11.15 a.m.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the Air Port of London, Croydon. 2.30 p.m.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS: ASSOCIATES' AND STUDENTS' SECTION.—Neville Hall, Newcastle-upon-Tyne. Paper, "The Lubrication of Colliery Coal Tubs," by Mr. L. H. Forster. 2.30 p.m.

MONDAY, FEBRUARY 18TH.

BRADFORD ENGINEERING SOCIETY. Technical College, Bradford. Lecture, "Remarks on Some Mechanical Variable-speed Gears," by Mr. H. Lindsey. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The Royal Technical College, Glasgow. "Some Investigations into the Performance of Tubular Radiators for Motor Vehicles," by Mr. H. Kerr Thomas. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, Westminster, London, S.W. 1. Paper, "Railway Brakes," by Mr. G. Bird. 6.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Shaw Lecture, "Thirty Years' Experience of Industrial Maladies," by Sir Thomas Morison Legge. 8 p.m.

MONDAY, FEBRUARY 18TH, TO FRIDAY, MARCH 1ST.

BRITISH INDUSTRIES FAIR.—White City, London, 10 a.m. to 8 p.m. daily; and Castle Bromwich, Birmingham, 10 a.m. to 6 p.m. daily.

TUESDAY, FEBRUARY 19TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Joint meeting with the Birmingham Metallurgical Society and the Staffordshire Iron and Steel Institute, in the Engineers' Club, Waterloo-street, Birmingham. "Fuel," by Mr. E. C. Evans. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Graduates Meeting. Address by Mr. H. R. Ricardo. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES' MEETING.—The College, Loughborough. Engineering Films. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The Engineering and Scientific Club, Wolverhampton. "Some Investigations into the Performance of Tubular Radiators for Motor Vehicles," by Mr. H. Kerr Thomas. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Paper, "The Electrical Heating and Ventilation of Bourne and Hollingsworth's Premises, Oxford-street," by Mr. A. H. Barker. 6 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. Paper, "The Fundamental Principles of Cutting," by Mr. J. F. Kayser. 7.30 p.m.

TUESDAY TO THURSDAY, FEBRUARY 19TH TO 21ST.

BRITISH COMMERCIAL GAS ASSOCIATION.—British Industries Fair, Castle Bromwich, Birmingham. Joint Gas Conference.

WEDNESDAY, FEBRUARY 20TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM GRADUATES.—At the Queen's Hotel, Birmingham. "Valve Gear for High-speed Singles," by Mr. E. M. Frank. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "History of the Development of Fast Dyeing and Dyes," by Mr. James Morton. 8 p.m.

THURSDAY, FEBRUARY 21ST.

INSTITUTION OF AUTOMOBILE ENGINEERS: LONDON GRADUATES.—At Watergate House, Adelphi, W.C. 2. "Some Notes on Gear Production," by Mr. C. Russell. 7.25 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham. Paper, "Deep Well Boring for Water Supply," by Mr. N. B. Bennett. 6 p.m.

INSTITUTION OF MINING AND METALLURGY.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Papers, "The Possibilities of Reviving Non-ferrous Metallurgy in Great Britain," by Mr. W. Cullen; "Some Notes on a Tunnel Driven at Rio Tinto, Spain," by Mr. C. R. Julian. 5.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Physics in Relation to Oil Finding," by Professor A. O. Rankine. 5.15 p.m.

FRIDAY, FEBRUARY 22ND.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Specification Notes and Good Practice Relating to Concrete and Reinforced Concrete Work," by Mr. A. S. Grunspan. 5.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: NORTH-EASTERN CENTRE.—Hotel Metropole, Leeds. "Reduction of Weight in Rolling Stock," by Mr. G. H. Taylor. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Electrical Precipitation," introduced by Mr. G. Baker. 7 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Film, "The Story of a Sparking Plug." 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "The Application of the Heavy Oil Engine to Yachts and Small Craft," by Mr. J. Calderwood. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Lily-stars of the Sea," by Dr. F. A. Bather, F.R.S. 9 p.m.

SATURDAY, FEBRUARY 23RD.

INSTITUTE OF BRITISH FOUNDRYMEN.—Grand Hotel, Manchester. Annual dinner.

TUESDAY, FEBRUARY 26TH.

ENGINEERING GOLFING SOCIETY.—At the Institution of Mechanical Engineers, Storey's Gate, Westminster. Annual General Meeting. 12.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. Paper, "The Deformation of Metals," by Professor C. H. Desch. 7.30 p.m.

WEDNESDAY, FEBRUARY 27TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Engineers' Club, Albert-square, Manchester. "Some Investigations into the Performance of Tubular Radiators for Motor Vehicles," by Mr. H. Kerr Thomas. 7 p.m.

INSTITUTION OF WELDING ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Paper, "Welding and Cutting Practice with Low-pressure Plant," by Mr. C. S. Milne. 7 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Resins," by Mr. A. F. Suter. 8 p.m.

THURSDAY, FEBRUARY 28TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Joint meeting with the Birmingham Metallurgical Society and the Staffordshire Iron and Steel Institute, in the Engineers' Club, Waterloo-street, Birmingham. "Metallurgy and the Evolution of the Balance," by Mr. W. A. Benton. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES.—King's Café, St. Peter's-street, Derby. Annual dinner.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES' MEETING.—Royal Hotel, Mill-street, Luton. "Some Notes on Gear-box Design," by Mr. G. Baston. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Queen's Hotel, Birmingham. Annual dinner. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Southall, Middlesex. South Midland District Meeting. 10.45 a.m.

FRIDAY, MARCH 1ST.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES' MEETING.—Regent Restaurant, 51, West Regent-street, Glasgow. "Inspection," by Mr. E. C. Philbrow. 8 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Frascati Restaurant, London. Annual dinner. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecture, "Notes on the Control of Electric Lifts," by Mr. L. S. Atkinson. 7.30 p.m.

SATURDAY, MARCH 2ND.

BELFAST ASSOCIATION OF ENGINEERS.—Thompson's Restaurant, Belfast. Annual dinner. 6.45 p.m.

MONDAY, MARCH 4TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES' MEETING.—The College, Loughborough. "Lubrication," by Mr. G. L. B. Hall. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Bristol. "Air-cooled Engine Repairs and Lay-out," by Mr. A. H. R. Fedden. 6.45 p.m.

TUESDAY, MARCH 5TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: GENERAL MEETING.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. 7.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: GRADUATES' MEETING.—Broadgate Café, Coventry. "Pistons," by Mr. W. S. Ascough. 7.15 p.m.

MONDAY, MARCH 11TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Birmingham. "Some Investigations into the Performance of Tubular Radiators for Motor Vehicles," by Mr. H. Kerr Thomas. 7 p.m.

TUESDAY, MARCH 12TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: LONDON GRADUATES.—At Watergate House, Adelphi, W.C. 2. "Metal Omnibus and Car Bodywork," by Mr. D. Swallow. 7.25 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Rover Sports Club, Albany-road, Coventry. General meeting. 7.30 p.m.

FRIDAY, MARCH 22ND.

INSTITUTION OF LOCOMOTIVE ENGINEERS: NORTH-EASTERN CENTRE.—Hotel Metropole, Leeds. "Experiments on Buffer Springs," by Mr. T. Robson. 7 p.m.

A GATHERING OF M-V SOCIAL COMMITTEES.—The annual gathering of the committees engaged in social or welfare work at the Trafford Park works of the Metropolitan-Vickers Company took place in the M-V Club Hall on Monday, February 4th. It was the twelfth gathering, and the committees represented numbered twenty-five. The chair was taken by Mr. G. H. Bailey (director), supported in the vice-chair by Mr. A. McKinstry (director). The chairman of the company, Sir Philip Nash, was also present. Mr. G. E. Bailey thanked the members of the committees for the voluntary work which they were doing, and which, he said, did so much to keep up the good spirit that pervaded the organisation. Sir Philip Nash congratulated the members of the committees on the good work of the past year, and pointed out the necessity of further fostering the spirit of good will in order that it should spread throughout all the branches of the new amalgamation into which the firm had now entered. Mr. Ritchie, as President of the M-V Australia Works Welfare Association, compared conditions in Australia with those in this country. Mr. McKinstry, as vice-chairman, also congratulated the committees on its activities.